JANUARY 1954

Power Engineering

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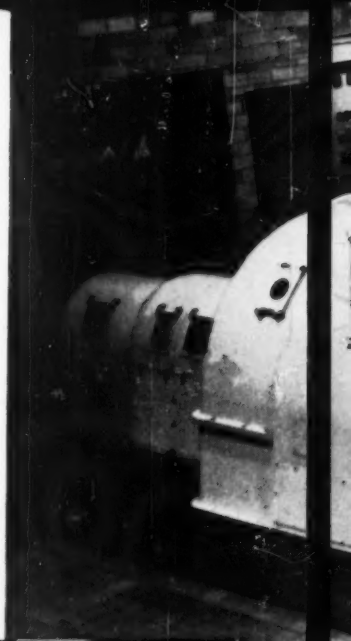
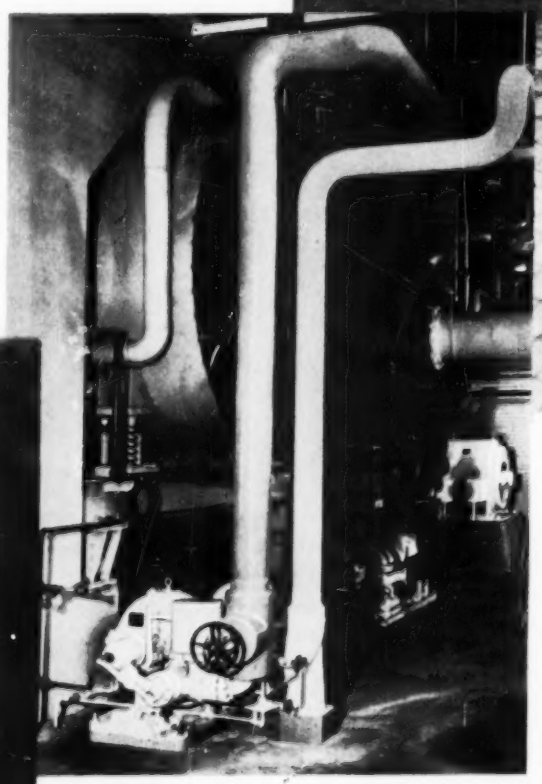
The *sixth* ELLIOTT unit

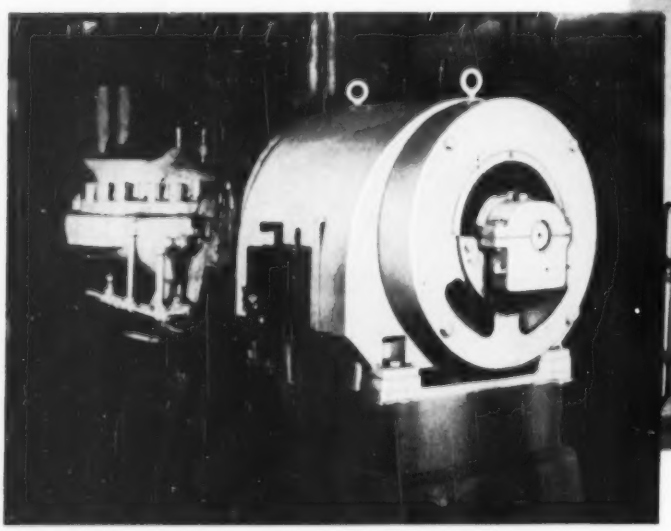


● Called a model plant, the Piqua, Ohio, utility has since its inception installed a succession of Elliott turbine-generator units. In 1933 two 4000-kw units started operation. Growing power demand brought the addition of another 4000-kw Elliott unit in 1939. Further expansion in 1946 saw the installation of a 7500-kw condensing turbine-generator and a 1000-kw noncondensing unit supplying process steam to an 8-in. distribution line. But Piqua continues to thrive and grow, dictating the recent installation of their largest unit, a 10,000-kw Elliott turbine-generator unit. Besides the turbine-generators, other major and auxiliary equipment in the Piqua plant is also Elliott, making the plant one in which Elliott Company feels a deep and abiding interest.

One end of the Elliott 12,000-sq ft divided water-box surface condenser which serves the new 10,000-kw turbine. In the immediate foreground, an Elliott 25-hp turbine, and in the middle distance, an Elliott 25-hp motor, both driving condensate pumps. In the background, an Elliott 200-hp motor driving an induced-draft fan.



Close-up of an Elliott 200-hp, 3600-rpm motor driving a boiler-feed pump.



M3-4

for Piqua, Ohio

THE BIG PARADE of Elliott turbine-generators at Piqua, began in 1933 with the two units in the far background of the above photo, continued through several more installations, and is brought up to date with the recent addition of the 10,000-kw turbine-generator unit in the immediate foreground.

For complete details on Elliott turbine-generators, contact your local Elliott representative or write Elliott Company, Jeannette, Pa.

ELLIOTT Company

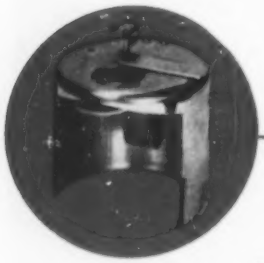
STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL BLOWERS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

STEAM TURBINE DEPARTMENT

For more data circle 501 on Post Card

Here's a *Real*

STEAM TRAP PACKAGE

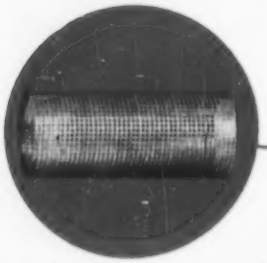


WANT FAST HEAT-UP OF OFF-AND-ON PIPE COILS, HEADERS, UNIT HEATERS, ETC.?

Speed heat-up with Armstrong thermic bucket traps. When steam is first turned on, air is pushed out the large thermic vent—fast! As soon as steam reaches the trap a thermic strip closes the vent, then the bucket functions as a regular bucket. Traps with thermic vent buckets discharge air 50 to 100 times faster than other traps.

NEED A CHECK VALVE AHEAD OF TRAP?

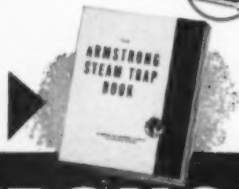
Just specify Armstrong with internal check valve. No check valve installation labor or fittings needed. Spring loaded action and vertical position minimize danger of dirt holding valve open. The Armstrong internal check valve is top quality—long lasting.



NEED A STRAINER AHEAD OF TRAP?

Save money with Armstrong built-in strainer traps. They cost less than a separate trap and strainer and save installation time and money. Stainless steel screen lasts a long time.

Get the full facts about all Armstrong traps. Send today for free Catalog J, The Armstrong Steam Trap Book.



ARMSTRONG MACHINE WORKS
810 Maple Street • Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

For more data circle 502 on Post Card

ENGINEERS' PREVIEW

DISCUSSING the contemplated move of the Engineering Societies headquarters from New York City, James Head, president of the United Engineering Trustees, Inc. said, "Frankly, we are looking for the highest bidder." This blunt statement by the man who initiated the move three years ago was a bit of a surprise to Chicago university and business men who had gathered to point out the advantages of the Chicago site to representatives of the Founder Societies.

A joint proposal of Illinois Institute of Technology, the University of Chicago and Northwestern University involved 5 acres of land on ITT campus, parking, food, postal and other services approximating a gift of $1,130,000. The proposed plan also involves inclusion of the John Crerar Library, one of the world's finest technical collections, and a new convention hall and civic center in the near vicinity.

Quarters now occupied by the societies are in a building given by Andrew Carnegie and are much too small for present needs. The property is valued at nearly $1,000,000 and is administered by the United Engineering Trustees, Inc. The building plus the depreciation fund gives the foundation net assets of about $2,000,000.

There is some question as to whether these assets of a tax-free, non-profit organization can be removed from the state. Tax-free operation is a major factor in selecting a new location. Washington and Pittsburgh have already made offers of land. Baltimore, New York and Detroit have also expressed an interest in the headquarters but at this writing have made no definite proposals.

* * *

HOME OF THE DERBY, of beautiful women and of (ahem) famous brands of *spiritus frumenti* — in short, Louisville, Ky., has cleared her skies. The way in which this was done is told in an interesting article (October 15th issue) of the *Review* of the Coal Producers Committee for Smoke Abatement. The sensible way they went about it is one of the things responsible for their success. There were no screaming headlines, no crusades, no witch hunts, but Louisville has now taken its place in the sun along with Columbus and Dayton, Ohio, Pittsburgh, and a number of other formerly smoke-obscured cities.

Incidentally, in that same issue of the *Review* is an interesting item showing that recent tests prove it is not the thousands of small domestic furnaces that have been causing much of the smoke in our larger cities. This, combined with checks in other cities, it is claimed, puts to rest the fallacious claim that the domestic fuel user is the big, bad wolf.

* * *

REVIEW of the American Society for Testing Materials Research is now available in a 22-page pamphlet prepared by the ASTM Administrative Committee on Research. It summarizes the work of the various technical committees as of May 1953. Copies are available without charge at ASTM Headquarters, 1916 Race Street, Philadelphia 3, Pa.

* * *

MAGNETOSTRICTIVE VIBRATIONS can now be used to apprehend burglars. These vibrations are used in a new burglar alarm that reports any disturbance of the ultrasonic waves transmitted in an enclosed area. Consequently, any intruder, by his motion anywhere in a room, can be detected.

Another interesting use of it is in detecting fires because the mass of air set in motion immediately affects the ultrasonic waves and this disturbance can be used to sound alarm.

* * *

H. H. LEVONIAN has been appointed vice president in charge of construction of the Kuljian Corporation of Philadelphia. He has supervised the building of such developments as the Bokaro Steam Power Station in India, and the Palermo Power Plant in Sicily.

continued on page 5

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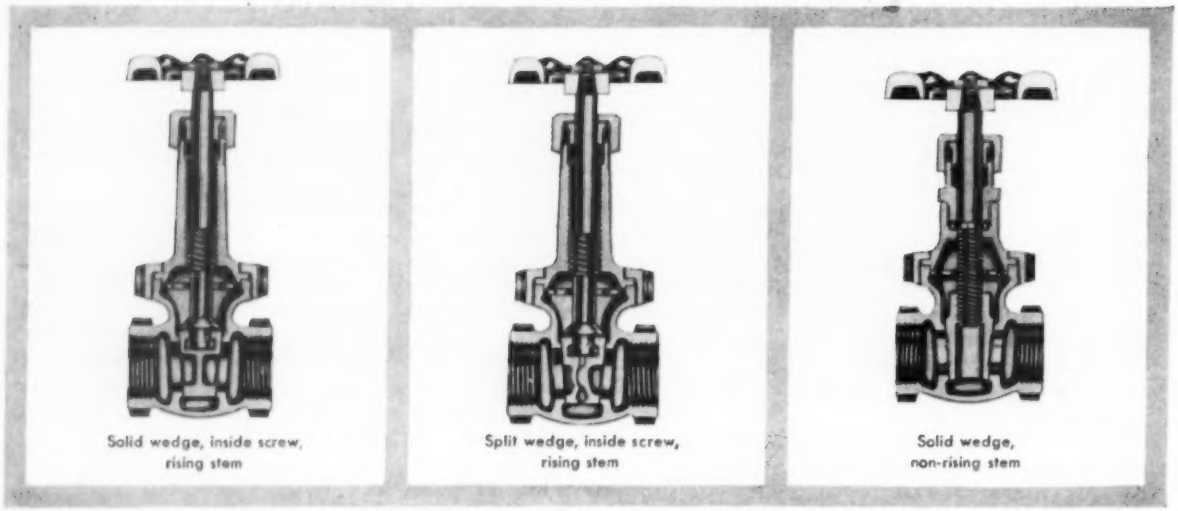
PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

Oh, I see



Solid wedge, inside screw, rising stem

Split wedge, inside screw, rising stem

Solid wedge, non-rising stem

. . . we've added 125 and 150 lb. bronze gate valves to our union bonnet line

WORKING PRESSURES
125 lb. W. S. P. 400° F.
150 lb. W. S. P. 400° F.

Success of our 200 lb. line of union bonnet bronze gate valves necessitates expansion of the line to include 125 lb. and 150 lb. classes. Sizes range from ¼ to 2 inches.

NOTE THESE ENGINEERING FEATURES:

This line has a flat seat on the bonnet which mates against the body, providing adequate bearing area for sealing.

Tight bonnet joint, but easy access to interior for inspection and service.

Full ports permit unobstructed flow.

Back-seating arrangement permits repacking while under pressure.

Split wedge has ball in socket contact . . . permits wedge to adjust itself to seat.

Slip-on type "T" head stem-to-wedge connection.

Lug-type hexes make valves compact and provide a better wrench-gripping surface.

To learn more about this expanding line of valves, write for our *Union Bonnet Bronze Gate Valve Catalog Folder.*

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

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FOUNDED 1881

VALVES | **FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON**

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INTEGRAL RELATIONSHIP between on-the-job efficiency and visual performance was discussed by a panel of experts at the annual meeting in December of the American Association for the Advancement of Science in Boston. Proper visual testing procedures are important in placing workers in jobs they are visually qualified to perform safely and efficiently. Chairman of the panel is Dr. N. Franklin Stump of Bausch & Lomb Optical Company, which, in cooperation with Purdue University and others, has done much work in visual-performance testing and has developed a device called the Ortho-Rater for this purpose. Full information about this can be obtained from Dr. Stump at 635 St. Paul Street, Rochester 2, N. Y.

* * *

CONSTRUCTION of natural gas pipe lines was discussed by the mine ministers of the Canadian provinces and federal authorities recently. These pipe lines, according to the Chicago *Sun-Times*, would run from western Canada into the United States and central Canada. It is expected that export licenses will be issued and construction may be expected in 1954. Canadian use of natural gas as fuel has been limited, but now the whole picture has been brightened by the discovery of large natural-gas reservoirs in Alberta and smaller ones in Saskatchewan.

* * *

A LOW-PRESSURE rupture disk made from gold may surprise you. But the development of such a disk has now been successfully accomplished by Baker & Company, Inc., which refines and works precious metals. Such gold rupture disks are now commercially available, the gold one having been designed originally for a specific chemical operation, where a bursting pressure of 18 psi was required.

Rupture disks from other precious metals, chiefly platinum, as well as non-precious metals, have been produced for 20 years. The hitch was to make a disk that would burst consistently at low pressure and still offer the benefits of precious metal while at the same time being economical. Outstanding use of rupture disks is in the chemical industry: the disks are also used in the petroleum industry, in hydraulic equipment, in fire extinguishers, in tank cars, and in some compressed gas installations.

* * *

NOT OFTEN does the head of an organization making engineering equipment get elected as mayor of a city. We do have a few men in the United States Congress, namely; Senator Flanders from Vermont and Senator Hinshaw from California, but there are not very many technical men in the mayors' chairs of our cities.

However, here is one. Joseph P. Lawlor, President of the General Filter Company of Ames, Iowa, has been elected Mayor of the City of Ames. He has at previous times served as councilman for the city. He has had wide experience with various water conditioning companies, has been a teacher of engineering subjects at Iowa State College and has a background that should prove of great benefit to the City of Ames.

* * *

HOWARD V. BARR has been appointed manager of the new Clifty Creek steam-electric generating plant now under construction by the Indiana Kentucky Electric Corp. on the Ohio River at Madison, Ind. This is one of the plants formed by a group of fifteen private electric utility companies of the Ohio Valley area for supplying electric power requirements of the U. S. Atomic Energy Commission's new Portsmouth area project in Pike County, Ohio. Mr. Barr's thirty-five years in power plants, in which he has risen from oiler to become manager of one of the world's largest steam stations, have all been spent with the American Gas and Electric System. Mr. Barr assumed his new position December 1, 1953.

* * *

SMALL SELF-CONTAINED sources of x-rays for use in industry and medicine may soon be a commercial reality as a result of work in progress at Armour Research Foundation of Illinois Institute of Technology, Chicago. The new x-ray source can be made in almost any size, from tiny pellets to larger blocks or sheets, and is entirely self-contained with no bulky electronic equipment and no wiring connections as in conventional generators.

MECHANICAL ENGINEERING, a feature-length film in color about training, job opportunities and the future in the field of mechanical engineering, has been produced by the School of Engineering at Michigan State College, East Lansing, Mich. Designed primarily for showing before high-school groups, the film includes scenes of training on the M.S.C. campus and professional engineers at work in Michigan industrial plants. The film will be shown to interested groups without charge on application to the Department of Information Services of Michigan State College at East Lansing, Mich.

* * *

RED FACE DEPARTMENT: — Omission of a line of type in the last item on page 8 of the November issue caused us to fire unintentionally the man in charge of the Fort Worth regional office of the Federal Power Commission.

The item should have read as follows: "Charles H. Spink is now engineer-in-charge of River Basin Power Planning and Licensed Projects at the Federal Power Commission office at Fort Worth, Tex."

The Regional Engineer, Wilbur F. Fairlamb is the administrative head of the Fort Worth regional office.

* * *

FIFTY-SEVEN EXPERTS, drawn from all industries, are scheduled to address the Plant Maintenance & Engineering Conference, to be held in Chicago concurrently with the Plant Maintenance & Engineering Show, January 25–28, 1954. The conference will be held at the Hotel Conrad Hilton, and the show at the International Amphitheatre.

* * *

COMMONWEALTH EDISON Company proposes to create a separate corporation to own and operate the gas properties of its Public Service Company division and has made application for the necessary authority. Under the program, the Public Service division, which supplies both electricity and gas in a large suburban and northern Illinois area outside Chicago, would continue its electric operations as at present, while the new gas company would be incorporated as the Northern Illinois Gas Company.

LETTERS TO THE EDITORS

A Better Chlorine Cylinder Lifter

I HAVE BEEN examining Fig. 4 ("Handle Your Chlorine Cylinders Safely," November, 1953 issue) which shows the lifting beam for chlorine cylinders. There are some features of this beam that I do not approve of. I am, therefore, sending a drawing of one that I think is better. (A reproduction of Mr. Livingston's drawing is shown below.)

There are two features of the beam shown in Fig. 4 (Nov. issue) that I think are wrong:

1. The two hooks swing loose in the pins. This means that it may be necessary to use your fingers in engaging or disengaging the hooks and running the risk of an injury. Furthermore, unless there is a man at both ends of the beam, the point of the far hook may hang up on the edge of the cylinder instead of the cylinder edge resting in the hollow of the hook.

2. The pin for the hook of the chain hoist is down between the beams, which may also result in injured fingers.

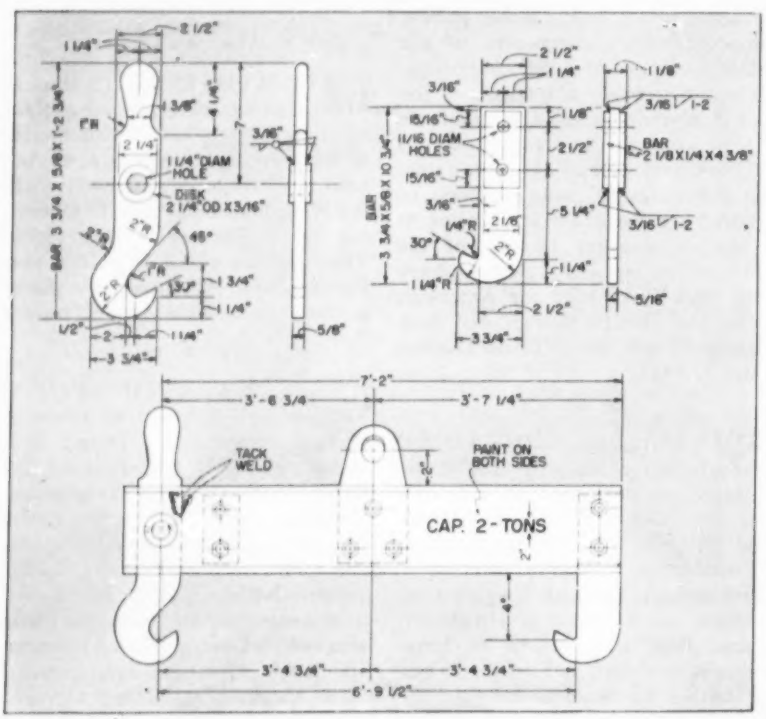
In the drawing enclosed, the far hook is rigidly bolted to the beam. This means that the operator can feel it go into the proper place at the other end of the cylinder. The near hook is pivoted and has a handle above the beam so that the hook can be slipped into position or released without risking injury to his fingers.

The lifting link is well above the beam where the chain hoist can be engaged safely. Although it is not shown in the drawing, this beam is provided with a shackle to take the hook of the chain hoist.

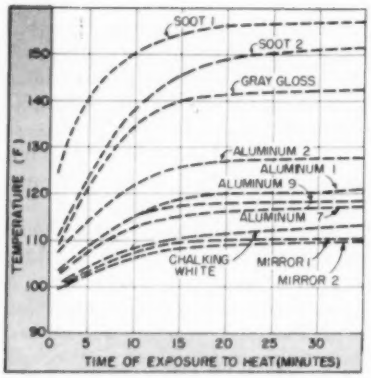
This particular beam has been in service for ten years and no one has ever suffered an injured finger or dropped a cylinder.

Los Angeles, Calif.

H. T. LIVINGSTON



Mr. Livingston's lifting beam for handling chlorine cylinders. Hook at far end is bolted rigidly to the frame while near hook is pivoted and operated by handle above beam. It has a ten-year safe record



Temperature equilibrium curves comparing chalking white and other paints support Jones' views on

Paint Heat Absorption

IN RESPONSE to the remarks of Wright M. Fedder, some tests were run on white chalking paint, with newly made up mirror and soot panels for standards. The tests duplicated those described in my article in POWER ENGINEERING of February 1953, "How Does Your Power Plant Paint Absorb Heat?"

A third set of temperature equilibrium curves is supplied for publication as a supplement to the previous two. This set includes the previous new or unweathered aluminum coatings Nos. 1, 2, 7 and 9, as well as the gray, marked "0" in the previous curves, for comparison with the chalking white. The old and new standards of soot covered steel and mirror are also added. The standards of the original tests, Soot 1 and M1, were higher than the Soot 2 and M2 of these new tests:

Standards	Old	New	Difference
Soot	155.1	151.5	−3.6
Mirror	110.0	109.0	−.10

Average difference, −2.3F, which may cover the range of all paints.

For comparison with the previous data, 2.3 F should be added to the 113.0 F obtained which would give a relative temperature of 115.3 F. The five aluminum coatings ran from 116.0 F to 125.1 F, averaging 120.1 F. The glossy new light gray paint ran 140.5 F (POWER ENGINEERING, February 1953, page 64).

These tests do indicate advantages to chalking white over an average aluminum, when new. The previous tests (reported in February) showed increases in heat absorptivity of aluminum coatings on weathering, from 5 to 15 F. If white paints retain their reflectivity in chalking, the advantage of white chalking paint would be enhanced with time and exposure, especially in sooty, dusty or general industrial areas.

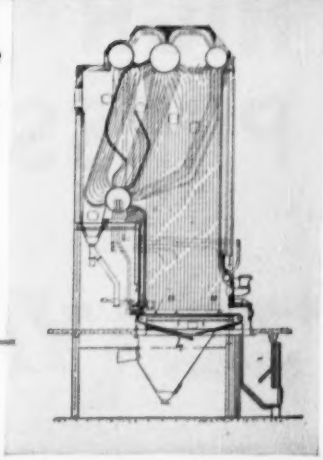
In a recent tour of eastern sea-

continued on page 100

Certified Smokeless Detroit RotoGrate Stokers . . .

At Capital City Products Co. (Columbus, Ohio)

Detroit RotoGrate Stokers in the plant of Capital City Products Company, Columbus, Ohio.



This Detroit RotoGrate Stoker has been certified smokeless by the City of Columbus, Ohio. This certificate awarded by the Citizen's Committee, and affirmed by the Smoke Regulation and Inspection Division is proof of performance.

Detroit RotoGrate Stokers operate without smoke because of their many features of design including precise control of fuel feed, grate speed and air supply.

RotoGrate is a modern spreader stoker with grates that move slowly forward discharging the ash at the front. They burn any type of Bituminous Coal or Lignite . . . handle rapidly fluctuating loads with uniform pressure over long periods.

Have you a smoke problem? Or a problem of fuel cost? Ask for details on the RotoGrate. No obligation.

DETROIT SINCE 1906 STOKERS

DETROIT STOKER COMPANY

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Works at Monroe, Michigan · District Offices in Principal Cities

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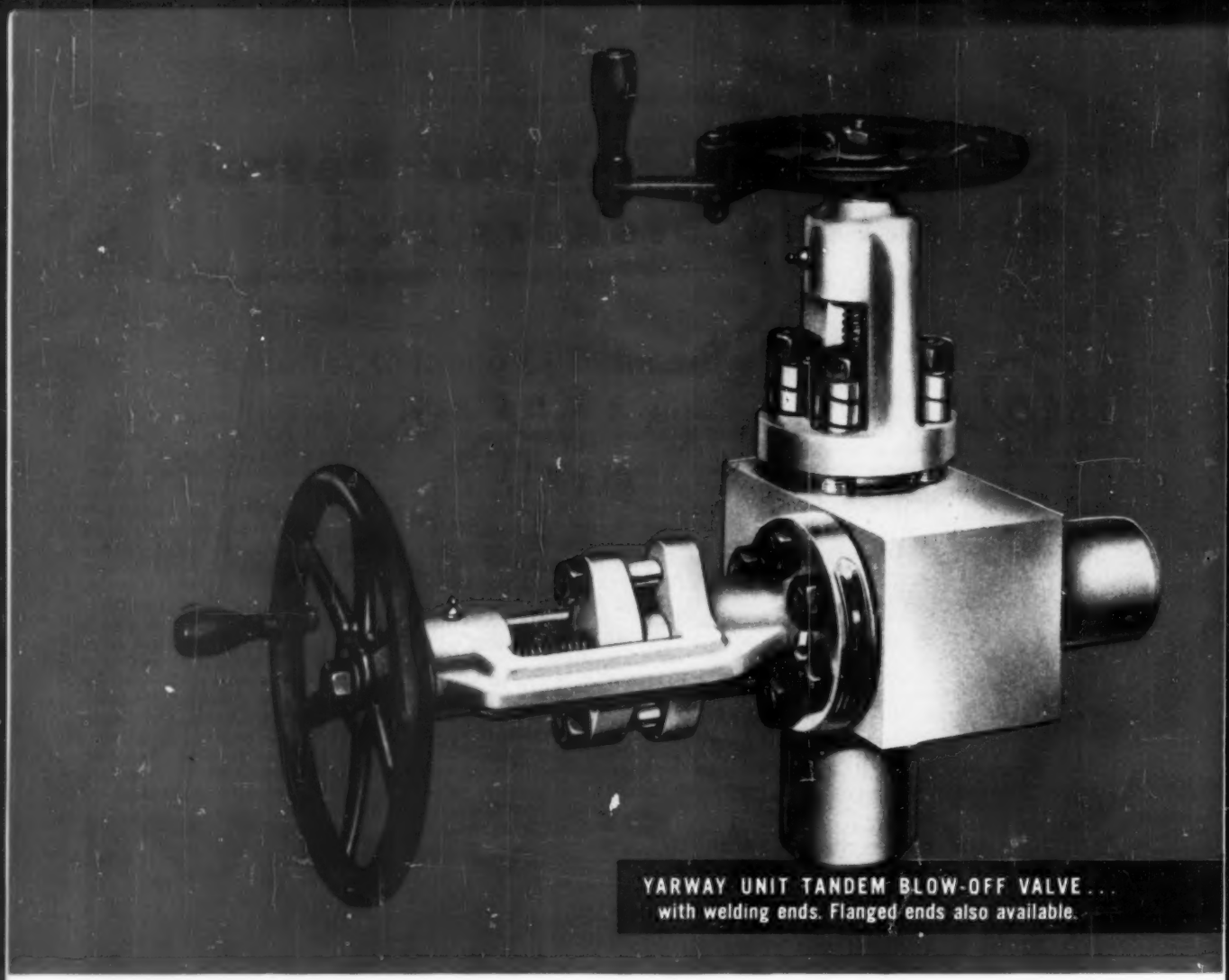


YARWAY UNIT TANDEM BLOW-OFF VALVE . . .
with welding ends. Flanged ends also available.

BUILT TO "TAKE IT" AT

HIGH PRESSURES

● As boiler pressures go up . . . so does the demand for Yarway Unit Tandem Blow-Off Valves. *Why do more than 4 out of 5 high-pressure boiler plants now use Yarway Blow-Off Valves?*

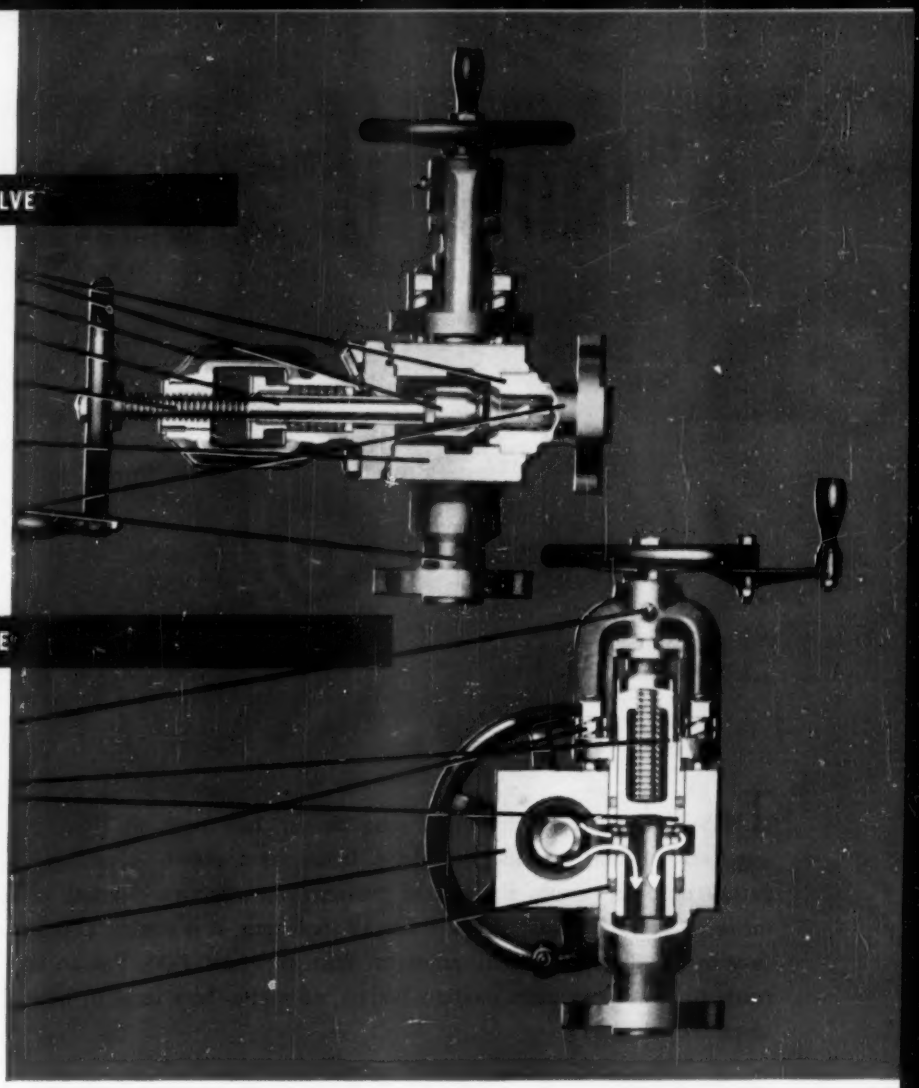
Yarway Unit Tandems are designed for strength, built to safeguard lives and investments, and to withstand severest acid-wash service.

A rugged, compact one-piece forged steel block serves as the space-saving common body for both valves, eliminating intermediate connections. Stelliting on seats and discs in the hard-seat valves provides longer life and better service. Balanced sliding plungers do the same on the seatless-type valves. Other design and metallurgy features add a high safety factor.

A FEW TYPICAL USERS

UTILITIES

Philadelphia Electric Company
Pacific Gas and Electric Company
Dallas Power and Light Company
Boston Edison Company
Cleveland Electric Illum. Co.



HARD-SEAT (Blowing) VALVE

Stellited and ground disc and seat.

Cast Steel Yoke.

Stainless steel stem.

Alemite lubrication (fitting on yoke hub) of stem and bushing threads.

One-piece forged body of carbon steel. Carbon-moly steel available on request.

Inlet and outlet nozzles welded into body. Flanged or welding ends provided.

SEATLESS (Sealing) VALVE

Alemite lubrication of plunger and ball thrust bearing in yoke.

Nitralloy plunger and lower follower gland. Stainless steel plunger and Ni-Resist gland available for acid wash service.

Yoke springs maintain required pressure on packing at all times.

One-piece forged body of carbon steel. Carbon-moly steel available on request.

Laminated lower packing ring with stainless steel reinforcing inserts.

Unit Tandems are available in the hard seat—seatless valve combination for pressures to 1500 psi, or in the hard seat—hard seat combination for pressures to 2500 psi. Both provide positive opening and closing with drop-tight shut-off.

Write for Yarway Bulletin B-434.

YARNALL-WARING COMPANY

114 Mermaid Avenue, Philadelphia 18, Penna.

BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY® blow-off valves

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Union Electric Co. of Missouri
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Indianapolis Power and Light Co.

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Procter & Gamble Company

Southern Kraft Corporation
Chrysler Corporation
Container Corp. of America
Eastman Kodak Company
American Viscose Company

"Build us a Long Retract..

this was the problem

Designers have talked of boilers 60 or more feet wide, but it had seemed impossible to clean them. Now this problem has been solved by the Vulcan long retract shown at the right. With two entering the furnace from opposite sides, boilers larger than have ever been built can be cleaned dependably.

THIS Vulcan long retractable soot blower has been thoroughly tested. It has dual electric-motor drive. It has the double-helix cleaning pattern that has made Vulcan the standard for effective cleaning of furnaces up to 50 feet wide. Yet, for all its length, it is compact. It is easy to install, operate and maintain. With this new T-30, Vulcan is ready to clean your most modern boilers, no matter how large or how small they might be.

COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE 4, PENNSYLVANIA

VULCAN Automatic

. and we do mean Long"

VULCAN
KNOW-HOW
COSTS MORE
—But is Worth it

Soot BLOWERS

For more data circle 506 on Post Card

Worker on Brooklyn Bridge is applying U.S. Holdtite Friction Tape over U.S. Uskorona splicing compound.

Splicing with "U. S." Tape on the Brooklyn Bridge

U. S. Uskorona and U. S. Holdtite® Tapes selected for new lighting system

Panoramic shot of Brooklyn Bridge's new lighting job.

With the remodeling of the main span and approaches of the Brooklyn Bridge by the New York City Department of Public Works, a new lighting system was installed. To insure that splices would have and would *retain* the same dielectric properties as the cables they covered, engineers selected U. S. Uskorona splicing compound, plus U. S. Holdtite Friction Tape. Uskorona is the best splicing compound made because it's the only one that protects against *both* ozone and moisture.

These United States Rubber Company products can easily withstand New York's severe extremes of weather conditions. For example, tests of four leading brands proved that Uskorona was the only one unharmed after 4 hours' exposure to ozone. Even when the exposure was extended to 500 consecutive hours, no damage occurred.

Naturally, these tapes splice easily, fuse quickly without heat or pressure. Electricians like the way the tape "handles". A staff of engineers is at every one of our 25 District Sales Offices to solve any industrial rubber problem. Or write to address below

Applying Uskorona to a solderless connector on a tap off to the lighting installation.

U.S.RUBBER

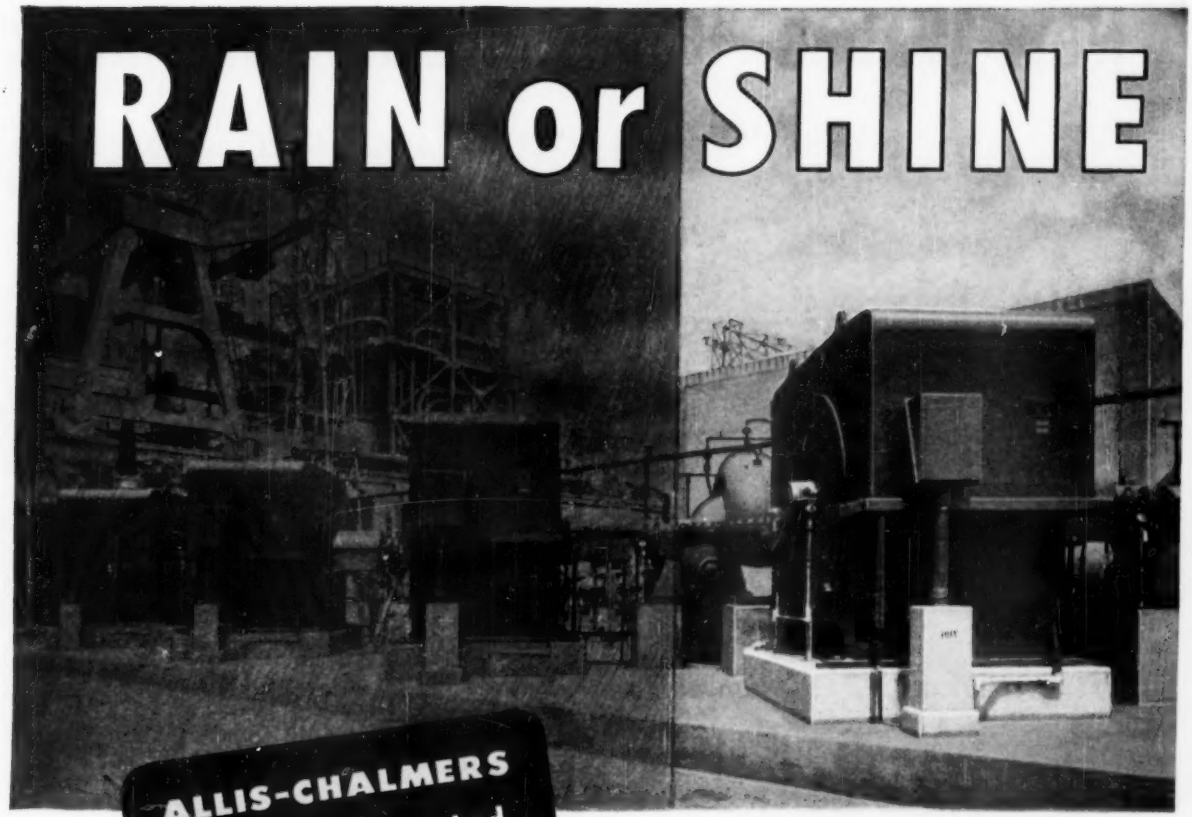
"U.S." Research perfects it
"U.S." Production builds it
U.S. Industry depends on it

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting

For more data circle 507 on Post Card



ALLIS-CHALMERS
Weather-Protected MOTORS

Low-cost outdoor installation plus dependable operation under all weather conditions

Economy plus reliability — regardless of weather conditions — was the combination demanded by Southern California Edison for the circulating water pump motors at the 250,000-kw Etiwanda Steam Station. And that's the combination delivered by the four Allis-Chalmers motors shown above.

Each of these modern weather-protected squirrel-cage motors is rated 900 hp, 4160 volts, 435 rpm. Smaller motors of similar design were supplied by A-C for the station's condensate booster pumps.

Proved by Special Tests

The weather-protected design has been tested under extreme conditions. Running at normal speed and voltage, motors of this type were deluged with water at rates up to 40 inches per hour — driven by winds up to 75 miles per hour. This was done repeatedly from all angles, but on inspection no moisture was detected on the windings. And other tests checked effectiveness in keeping out wind-driven fine sand — a serious threat at this west coast installation.

Movie and Bulletin Available

See how A-C test-proved these motors. Ask your A-C representative to show you the 12-minute movie *The Sky is the Roof*. Or write for Bulletin 05B7874. Allis-Chalmers, Milwaukee 1, Wisconsin.

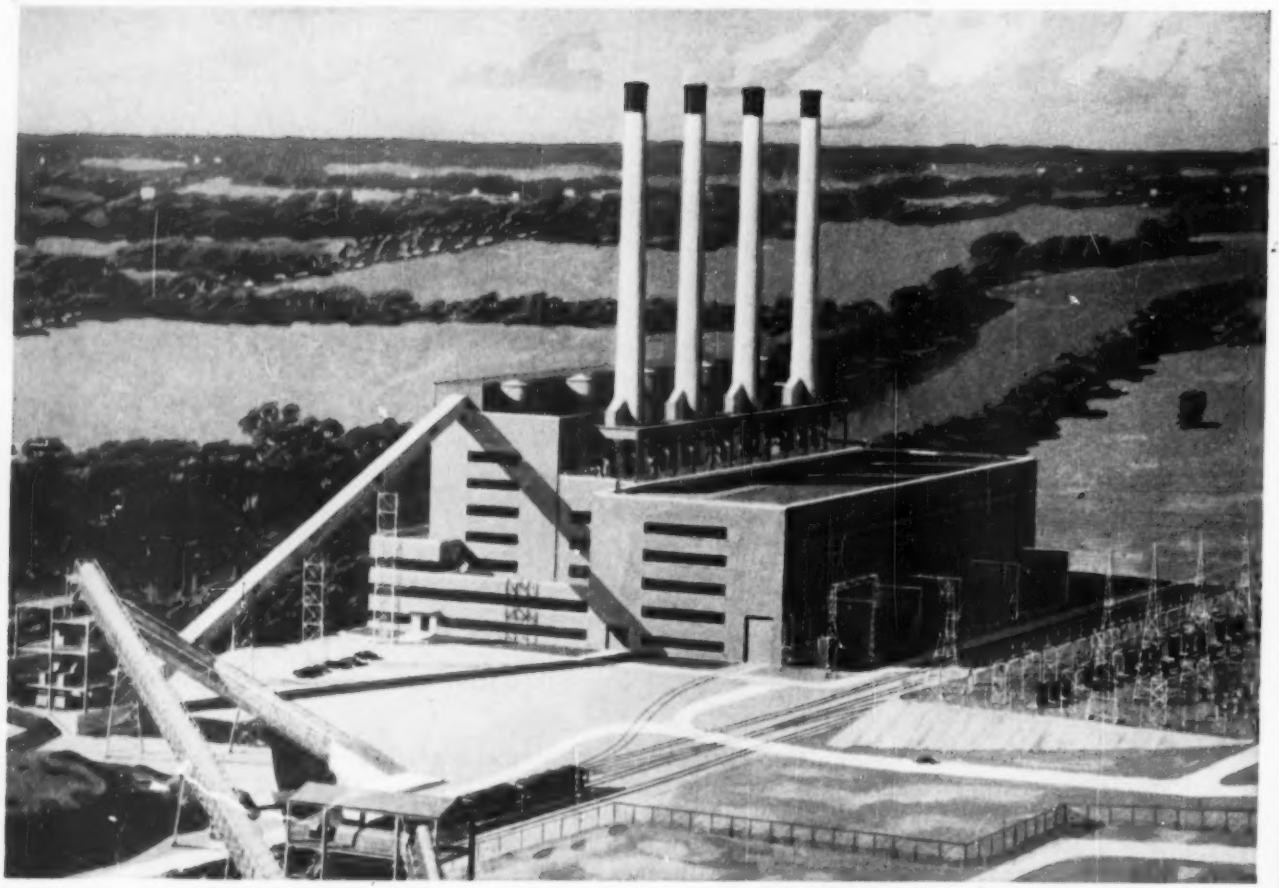
A-4176

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

For more data circle 508 on Post Card

New Wabash River Station of Public Will Boost System's



NEW WABASH RIVER STATION, West Terre Haute, Ind., of the Public Service Company of Indiana, Inc., designed by Sargent & Lundy, Inc., consulting engineers, will have four Foster Wheeler reheat-type steam generators with the following capacity:

Maximum continuous capacity

Primary steam flow.....700,000 lb per hr
Reheat steam flow.....624,000 lb per hr

Operating pressure

Superheater outlet .....1500 psig
Reheater outlet ..... 401 psig

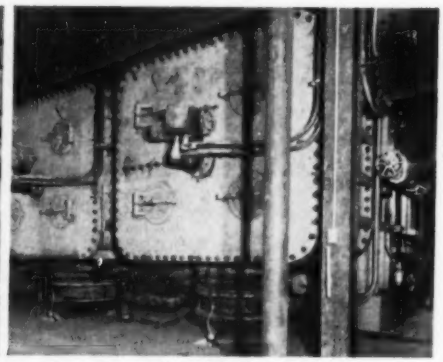
Final steam temperature.....1005 F

Final reheat temperature.....1005 F

Feed water temperature..... 451 F

Coal pulverized by Foster Wheeler ball mills, two for each steam generator.

Foster Wheeler vertical circulating pumps, two of which provide a total of 62,000 gallons per minute of cooling water to each condenser.

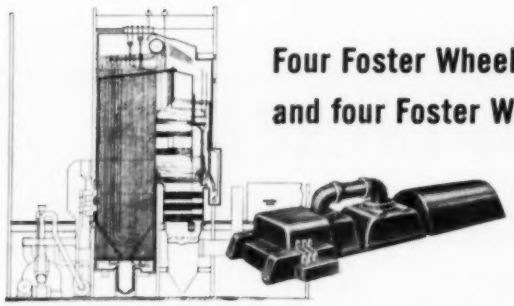


One of four "double-flow" Foster Wheeler condensers, of the 70,000 sq ft rectangular, two-pass design.

Service Company of Indiana, Inc.

Output Capability to 940,000 kw

...*with four reheat cycle steam generators!*



Four Foster Wheeler 700,000 lb/hr reheat steam generators and four Foster Wheeler 70,000 sq ft "double-flow" condensers will serve turbines each with a gross generator output of 100,000 kw.

Designed to operate on the reheat cycle, the four Foster Wheeler steam generators at the new Wabash River Station of the Public Service Company of Indiana, Inc. will have an aggregate capacity of 2,800,000 lb steam per hr.

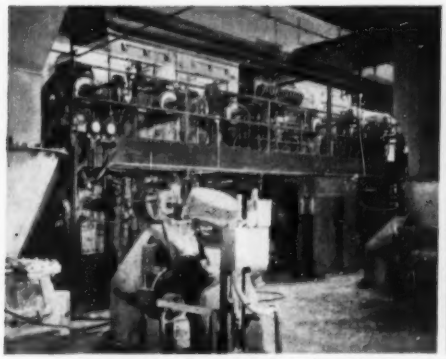
The use of combination radiant and convection superheaters makes possible precision control of final steam temperature over a wide load range. Since superheating is done partly in the radiant section, the gas temperature leaving the furnace can be sufficiently reduced so that, even with the Indiana coal used, complete freedom from furnace slagging is assured.

An all-convection reheater is located deep in the low-gas-temperature zone beyond the convection superheater section. Here safe metal temperatures are maintained during starting, shutting down and under emergency operating conditions. Reheater final steam temperature is controlled by regulation of by-pass dampers located at the economizer outlet.

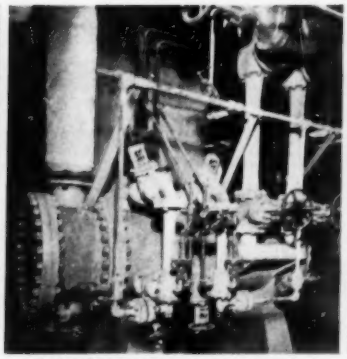
Outstanding features of the "double flow" type condenser are its inherent deaerating action and its complete utilization of available headroom. Also incorporated is a special provision for reversing the circulating water flow, thereby providing a desired cleaning action of condenser tubes.

FOSTER WHEELER CORPORATION, 165 Broadway, New York 6, N. Y.

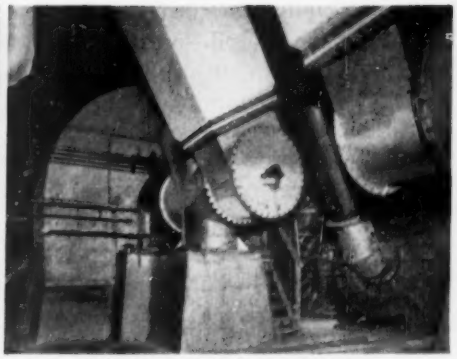
FOSTER WHEELER



Firing aisle of one of the reheat boilers shortly after initial start-up.

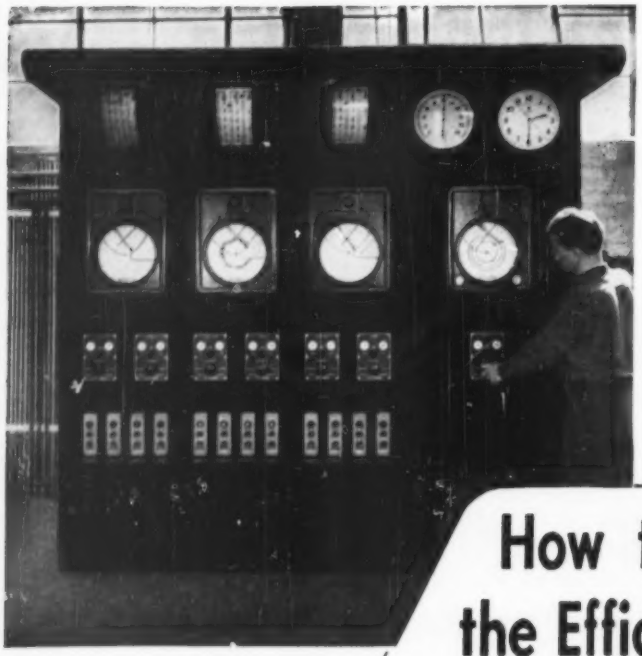


Twin-element two-stage steam-jet air-ejector, with combined surface inter- and after-condensers, maintains vacuum in each 70,000 sq ft condenser.



Exhausters and ball mill pulverizers located on basement level.

For more data circle 509 on Post Card



These Bailey Boiler Controls at the Chicago Pneumatic Tool Company's new plant in Utica, N. Y. insure efficient operation of three 25,000 lb per hour, 100 psi, spreader stoker-fired boilers

How to INCREASE the Efficiency of YOUR BOILER-ROOM DOLLAR

Before you get steam you've got to spend dollars—so dollars are a form of energy.

And if your boiler-room dollars are invested in equipment that isn't working efficiently, economically, your "investment" is poor.

That's where co-ordinated controls by Bailey can help. Here's why they'll increase your "boiler-room investment efficiency":

1. Complete Range of Equipment—fully co-ordinated. You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. Engineering Service—backed by experience. No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. Direct Sales-Service — conveniently located near you. Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better "boiler-room investment" efficiency —for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-111-0

BAILEY METERS

BAILEY METER COMPANY

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

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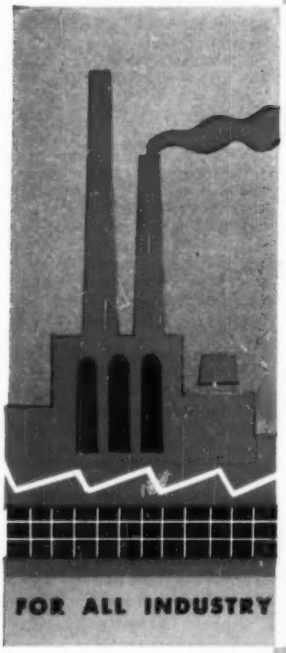
FOR 100 YEARS . . .

A NAME TO RELY ON

WICKES

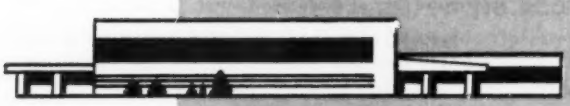
RECOGNIZED QUALITY SINCE 1854



FOR ALL INDUSTRY

For almost a century, WICKES Steam Generators have been supplying dependable, low-cost steam to industries and institutions. Today, in every State in the Union and in foreign countries, refineries and natural gasoline plants, steel mills, foundries, ships, chemical processing plants, atomic energy installations, public utilities and many other industries depend on WICKES for efficient steam production. In schools, hospitals, public buildings and institutions, WICKES Boilers supply steam for heat and power.

WICKES can fill your requirements for all types of multiple drum boilers with capacities up to 250,000 lbs. steam per hour at pressures up to 1000 psi., adaptable to any standard method of firing. In pressures up to 900 psi. with sustained steam production up to 40,000 lbs., WICKES Boilers can be shop assembled ready for immediate installation. For complete information, consult your nearest WICKES representative or write us today!



FOR PUBLIC BUILDINGS AND INSTITUTIONS

FOR SHIPS

WICKES

THE WICKES BOILER CO., SAGINAW, MICHIGAN
DIVISION OF THE WICKES CORPORATION • RECOGNIZED QUALITY SINCE 1854

SALES OFFICES: Albuquerque, N. M. • Boston • Buffalo • Charlotte, N. C. • Chicago • Cleveland • Dallas • Denver Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City Portland, Ore. • Saginaw • Salt Lake City • San Francisco • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D. C.

151

For more data circle 511 on Post Card

Sound Selling vs. Smart Talk

Today, essentially, all of the chemical companies have established technical service and sales-supporting technical work. One corporation has 25 laboratories devoted to this type of work supported by 29 field laboratories. The total investment by the industry in such facilities, must run well into the tens of millions of dollars, which is one measure of how importantly the industry regards the sales function.

It is now estimated that 70% of the average chemical company's sales staff is technically trained compared with probably less than 25% only 20 years ago and an insignificant percentage 30 years ago. This current mode of selling is epitomized in the slogan of one chemical manufacturer, namely, "Serving Industry through Practical Applied Science."

From an article: "Selling . . . Its Importance in the Chemical Industry," by J. Warren Kinsman, Vice-President, E. I. du Pont de Nemours & Co., Wilmington, Del., in Chemical Engineering Progress.

Nalco appreciates the use of its slogan, "Serving Industry through Practical Applied Science", as an example of the modern approach to chemical sales. 100% of Nalco's field service representatives are technically trained to help industry make full practical use of the chemicals and methods developed by the Nalco Laboratories: Water, Microbiological, Physical Chemistry, Organic Chemistry, Corrosion, Micrography, Metallographic, Experimental Boiler, Combustion, Oil Treatment, Paper, Ion Exchange, Weed Control, Production Control.

NATIONAL ALUMINATE CORPORATION
6224 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario

THE *Nalco*® SYSTEM . . . Serving Industry through Practical Applied Science

For more data circle 512 on Post Card

HELPFUL BULLETINS

These new and revised publications offer help on many of your operating and maintenance problems. To order, use the Reader Service Cards on page 113.

ELECTRICAL EQUIPMENT

101 A-C Motor Frame Chart — This selection wall-chart which shows comparison between old and new NEMA standard dimensions for a-c motors from 1 to 30 hp provides a handy reference for determining differences in frame dimensions. Covers dimensions for polyphase, squirrel-cage, polyphase round-rotor, and single-phase, foot-mounted motors, also flange-mounted motors, drip-proof and totally-enclosed, fan-cooled. Westinghouse Electric Corp.

102 Improved Motors — Manufacturer's new Tri-Clad "55" motors, built in 1 to 30 hp ratings to latest NEMA dimensions, are explained in three full-color picture-story bulletins containing complete descriptions of new maintenance, performance and protective features. Sixteen-pp Bulletin GEA-6013 discusses drip-proof models, 8-pp Bulletin GEA-6012, enclosed motors; and 14-pp Bulletin GEA-6027, new gear motors. General Electric Co.

103 Motor Lubrication — Three methods of lubricating electric motors — cartridge, standard open and company's Lubriflush — are compared in 8-pp Bulletin 1848. To demonstrate action of relubrication in Lubriflush bearings, a series of natural color photos of a transparent bearing housing is reproduced. Necessity of annual lubrication is demonstrated photographically. U. S. Electrical Motors Inc.

104 Motor Control — Company's Limitamp high-voltage motor control, its operation and application are described in 16-pp picture-story Bulletin GEA-5409B. Uses photographs, charts and diagrams to explain control system's economic and safety features, accessory and component equipments. Typical dimensions of full and reduced voltage control panels are included. General Electric Co.

105 Isolator Data — Application and ordering information on air interrupter isolators and air interrupter cable isolators for applications through 15 kv are provided in 12-pp Bulletin 138. Includes dimensions, mounting details and data on terminals. Electrical Engineers Equipment Co.

106 Synchronous Motor Control — Electrical operation of synchronous motors and areas where control is essential are described in illustrated 16-pp Bulletin GEA-5873. Problems concerning synchronous motor applications and their solution by correct control equipment are explained in a question-answer technique. Describes various control units and gives rating and dimensional data. General Electric Co.

107 Wire Code Changes — This wall chart covers 1953 changes in wire, cable, conduit sections of National Electrical Code. Front shows quick reference chart of all presently approved wire and cable insulations, their allowable temperature ranges. Reverse side explains other changes. Triangle Conduit & Cable Co., Inc.

108 Handbook on Storage Batteries — This 60-pp book of instructions and technical data is the sixth edition of this company's battery service manual. Provides a brief treatise on the theory of the lead-acid battery. Gives detailed instruction on the care and operation of batteries, on maintenance and repairs, and on standard and special parts. Gould-National Batteries, Inc.

109 Variable Transformers — Description of company's Adjust-A-Volt variable transformers given in Bulletin 553–5, 18 pp., includes design and construction, dimension and performance characteristics of various models of transformers for built-in and bench applications. Terminal and tap arrangements, as well as circuit diagrams, are included, also index of specifications and applications for single and 3-phase transformers. Uses of toroidal windings are discussed. Standard Electrical Products Co.

110 For High Current Testing — Catalog 953 describes six models of a portable high current test instrument designed for economical and safe checking and calibrating of current actuated devices. Fully illustrated; includes specifications, application data and prices. Multi-Amp Corp.

111 Transite Ducts — This 12-pp illustrated bulletin presents installation and maintenance information on Transite conduit for exposed work and installation underground without concrete encasement, and Korduct for installation in concrete. Shows how these materials have cut cable subway costs in public utilities and other industries. Johns-Manville.

WATER TREATING

112 For Industrial Water Softening — Greensand, zeolite and resinous exchange water softeners are described in 8-pp Form S-105. Discusses features and applications of each of these basic types and illustrates some installations. Includes capacity data and general specifications. Also describes and pictures controls for water softeners, pressure filters and deionizers. Illinois Water Treatment Co.

113 Slide Comparators — This informative 12-pp folder gives full ordering information on slide comparators for pH and phosphate, for pH and chlorine and for pH and water analysis. Fully illustrated, gives step-by-step instructions for use of basic outfit. Brief text covering each model tells its features and field of application; gives prices. W. A. Taylor & Co., Inc.

VALVES, PIPING ACCESSORIES

114 Solenoid Operated Valve — Eight-pp Technical Bulletin W-7 describes solenoid operated valves which automatically open or close in response to time clock, pressure switch, manual switch or other impulse. Contains operating instructions, illustrated parts lists, and dimensions for these valves, used in steel, processing, pulp and paper mills, rubber and chemical plants, and water works. Golden-Anderson Valve Specialty Co.

115 Valve Selection Chart — A handy, desk-size flexible plastic chart shows port and stop arrangements of manufacturer's multi-port valves. Front of chart has diagrammatic sketches of four types of valves, each with revolving two-color plastic disc attached to center to illustrate fluid traffic control. Back of chart shows other positions possible with different arrangements. Rockwell Mfg. Co.

116 Metal Expansion Bellows — Six-pp Bulletin 300 describes metal expansion bellows for conveying gas and liquids. Diagrams show advantages of welded-diaphragm construction in withstanding high temperature, vibration and corrosion. Specification sheet included. Titeflex, Inc.

117 Expansion Joint Design Guide — Bulletin 135, 24-pp, contains engineering application and selection data for pipeline expansion joints. The guide features a discussion of the types of expansion joints available and types of pipeline motion solved by them. Also covered are expansion joint design considerations, and installation instructions. Includes piping layout illustrating various expansion joint applications. Flexonics Corp.

118 Filterless Purifiers — Bulletin 201 tells how company's Hi-eF purifiers remove dirt and moisture from steam, air, vapors and gases. Charts aid in selection of size needed. Bulletin includes installation diagrams, tables of dimensions and weights, buying information. The V. D. Anderson Co.

119 Pipe Insulation — Bulletin F 1–100 features on-the-job installation photographs of cellular glass insulation for pipe temperatures between −300 and 800 F. Complete listing of physical properties and condensed recommended specifications make this an excellent reference. Pittsburgh Corning Corp.

MECHANICAL POWER TRANSMISSION

120 Geared Flexible Couplings — Folder 2375 describes and pictures geared flexible couplings offering light weight and high capacity for high speed and high torque applications. Dimensional tables and selection data provided. Link-Belt Co.

121 V-Link Belting — Twelve-pp Data Book B220 lists prices, sizes and typical applications of manufacturer's V-link belting, together with engineering and maintenance data. Tables and charts give installation and selection information. Brammer Corp.

INSTRUMENTS AND CONTROLS

122 Instrument, Control Boards — Eight-pp Bulletin 700 covers a line of control switchboards designed to present an instantaneously coordinated picture of an entire process. Besides illustrating representative equipment, bulletin diagrams NEMA standard designs of vertical switchboard, enclosed switchboard, dual switchboard, control desk, benchboards. Continental Electrical Equipment Co.

123 Flow Signal Transmitter — Bulletin 2653 illustrates and describes a combination 1500-psi liquid line-flow measuring element and pneumatic flow-signal transmitter with square root extraction cam for linear indication, recording or

control of furnace fuel and process liquids. Discusses advantages of using integral measuring orifice with differential-pressure bellows, requiring no sealing fluids. Stresses accuracy of instrument. Hagan Corp.

124 Fluid Control Equipment — Small valves, pressure regulators, stainless steel cylinders, flow gages are described and illustrated in 66-pp Catalog 2. Provides application suggestions and ordering information as well as detailed engineering data. Also listed are large and small capacity oxy-gas torches. Hoke Inc.

125 Flow Control — Introducing manufacturers' Model 59 valve-mounted controller for high speed flow application, 8-pp Bulletin 470 divides a typical flow control system into four components: M/59 controller; set point transmitter (M/53 recorder); measurement transmitter (d/p cell), and Stabiflo control valve. Discusses provisions for proportional, derivative and reset control actions. Complete controller specifications and diagrams are included. The Foxboro Co.

126 Temperature Controller— Twelve-pp Bulletin P-811 introduces an electronic temperature controller, with range covering —100 to 600 F. Contains specifications, prices, application information on single-point and new cascade model, also data on resistance thermometer elements and wells, and control motors. Industrial Div., Minneapolis-Honeywell Regulator Co.

127 General-Purpose Oscillograph — Twelve-pp Bulletin GEC-449B describes and gives pricing data on an oscillograph for use in investigation, design and testing of many types of machines. Tells how it makes simultaneous records of voltage, current, time, speed, pressure, strain and sound. Includes other electric instruments for industrial and central station use such as long-scale switchboard instruments, phasing-out voltmeter, Type AK Hook-On instruments. General Electric Co.

128 Oscillator Controls — Bulletin 34-10 presents the Frahm oscillator control, described as a miniature tuning fork for use in an electronic oscillator to provide a stable output frequency. Tells how the control is built, explains its operation and illustrates a circuit suitable for most purposes. James G. Biddle Co.

129 For Supplementary Alarms — The Levalarm, an electronic device designed as an addition to this company's liquid level indicators to utilize one or more visible or audible signals away from the indicator, is described in Section C6.1 of Catalog 600. Shows component parts and explains how the Levalarm works. The Reliance Gauge Column Co.

130 Vertical Scale Indicator — Illustrated Bulletin 1541 describes 6½-in. wide Elektronic instrument for rapid and precise multiple indication of any variable that can be transformed to millivolts within limited panel space. Lists components, specifications. Industrial Division, Minneapolis-Honeywell Regulator Co.

131 Venturi Tube — Company's Type VE venturi tube, a primary device used to produce pressure differentials from flowing liquids for actuating rate of flow meters, is discussed in this illustrated bulletin. Shows how any low-velocity, low-pressure flow of liquids containing solids can be measured in connection with venturi meter. Simplex Valve & Meter Co.

METALS, METAL PRODUCTS

132 Data on Chromium Steel — Bulletin A-49, 32 pp, on corrosion resistance of chromium nickel steels contains 18 tables showing results of tests on numerous austenitic stainless steels in acid, neutral and alkaline solutions. Covers mechanism of corrosion resistance; factors affecting corrosion; behavior in various corrosive environments, marine and industrial atmosphere, in organic and inorganic acid salt solutions and in halogen salts and weak and strong bases; and preferred practice in construction and use of these steels. The International Nickel Co., Inc.

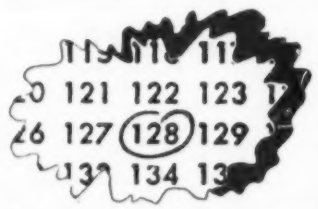
133 Aluminum Strip — This 20-pp booklet covers company's work in the production of Truspec cold-rolled aluminum strip and tells advantages of this product. Explains method of determining directional properties of wrought aluminum alloy strip. A section of this booklet is devoted to technical data on five basic alloys offered, including fabricating characteristics, standard temper designations, physical and mechanical properties, weights, conversion factors and other pertinent data. Scovill Mfg. Co.

134 Welding of Nickel Alloy Steels — A study of the various welding techniques for nickel alloy steels, including some of the newer inert gas processes, is presented in 44-pp Bulletin A93. Discusses electrodes, preheat treatments and post-heat treatments; also discusses typical results that can be expected for the low alloy high strength steels, low carbon and medium carbon engineering alloy steels and special steels. Booklet is illustrated with photos and design drawings, includes tables of properties, test results. The International Nickel Co., Inc.

BOILERS AND AUXILIARIES

135 Water Tube Boilers — Bulletin SB-49 describes manufacturer's Type C boilers, designed for large water holding capacity, fast steaming, large steam relieving surface. Discusses method of steam take-off utilized in these three-drum boilers and gives dimensions. Erie City Iron Works.

136 Shop Assembled Boilers — Two-drum, bent tube package units for steam and high pressure and high temperature hot water are the subject of this illustrated bulletin. Gives construction details, dimensions, ratings. Springfield Boiler Co.



It's easy to get these free catalogs — just circle item numbers of those wanted on the two post cards provided on pages 113-114

137 Boiler Feed Systems — Catalog 55-A, 16 pp, presents condensation drainage and automatic boiler feed systems engineered for dependability, low maintenance and long service. Pump controls, pumps and receivers are covered in detail; and full information is given on the use and features of the standard system, as well as equipment furnished with it. Book also provides data on pre-heat systems, heat reclaim systems, spray-type and zero-oxygen deaerating systems. Fred H. Schaub Engineering Co.

138 Tube Expanders — Bulletin R-100 covers construction and operation of company's refinery type expanders. Provides illustrations of six basic types of expanders. Includes complete charts on expander numbers, sizes, weights and dimensions; also ordering instructions and price list. The J. Faessler Mfg. Co.

DUST CONTROL

139 Electrical Precipitators—Power engineers concerned with precipitators for recovering industrial dusts and mists will find useful information in 40-pp illustrated Booklet C-103. Summarizes latest advancements in company's equipment, outlines various types of electrode designs, shell constructions and mechanical rectifier systems and gives information on combination mechanical-electrical recovery systems. Lists types of precipitators, compares mechanical and electronic tube rectifiers, and gives useful information on collection problems. Western Precipitation Corp.

140 Gas Cleaner — Bulletin OH, on open hearth stack gas cleaning, discusses special design features of Cottrell electrostatic precipitator for open-hearth steel making applications. Explains electrostatic method which, manufacturers say, offers high dust collection efficiency at normal operating and maintenance costs. Illustrates operating and construction details. Research Corp.

SAFETY EQUIPMENT

141 For Power Plant Protection — Here's a 36-pp illustrated booklet showing how company's engineering and inspection services work and what they mean to power plant equipment protection. Discusses general accident prevention work, inspection and testing of electrical machinery, boiler and pressure vessel inspection, research, metallurgical examinations, insulation and oil voltage testing. Includes an inspection frequency check chart for boilers and pressure vessels. Mutual Boiler and Machinery Insurance Co.

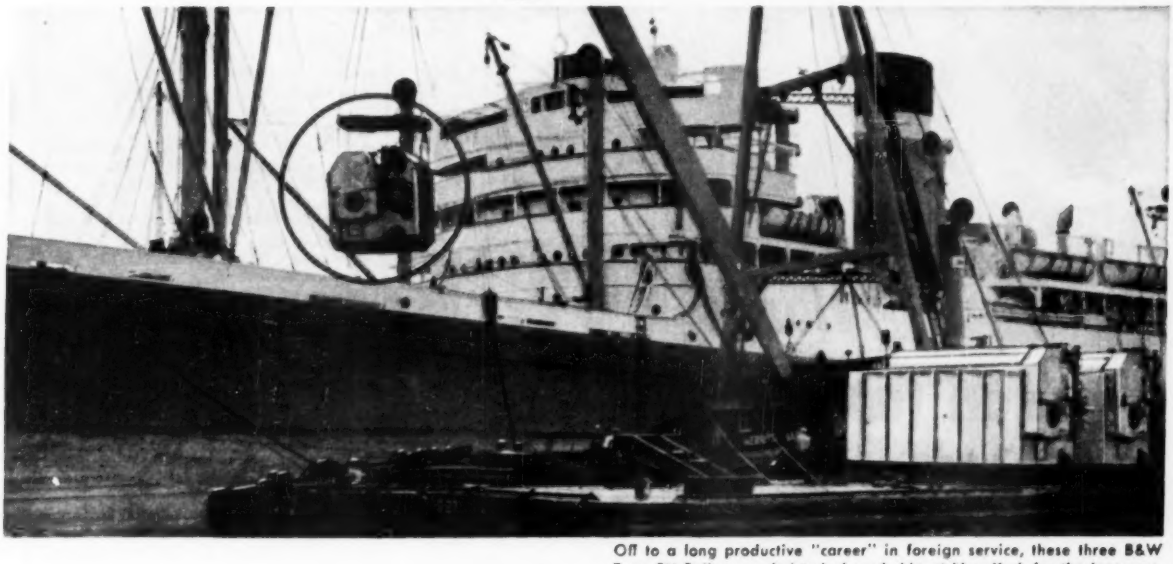
142 Safety Devices — Bulletin C-54 lists prices of safety devices for steam and hot water boilers and hot water tanks. Gives information on company's boiler feeders, low water cut-offs, pump controls and pressure and temperature relief valves. Features service recommendation chart for selection of proper control within each of four major job classifications. McDonnell & Miller, Inc.

143 Valve Capacity Computer — Now available to power engineers is a slide-type computer for safety relief devices on pressure vessels containing liquid refrigerants. Shows how to find minimum required discharge capacity in pounds of air per minute, and how to select a relief valve having the required capacity. Also gives information on number of safety devices needed. Henry Valve Co.

144 Safety, Relief Valves — Sixteen-pp Catalog Section E gives ordering and

keeping steam cheap . . .

BOILERS FOR Bombay



Off to a long productive "career" in foreign service, these three B&W Type FM Boilers are hoisted aboard ship at New York for the long voyage to Bombay, India. They will be followed shortly by another one.

more and more **B&W** Type **FM** Units are going into foreign service

Loading for their trip to the other side of the earth, these three B&W Integral-Furnace Boilers, Type FM, typify the growing demand for these compact, shop-assembled units by industries in many parts of the world. Ordered by the Standard-Vacuum Oil Company for their new Stanvac Bombay Refinery in India, these self-contained, B&W steam-generating units each will provide 20,000 lb of superheated steam per hr.

A water-tube unit with a fully water-cooled furnace, the B&W Type FM Boiler is designed for indoor or outdoor operation . . . is suitable for single or multiple-unit installation . . . is simple in operation, with push-button start and stop, and automatic control for meeting quick load variations. Delivered assembled, the FM Boiler is ready to be lifted or skidded into position, connected to fuel, water, and electric services, and put to work.

Combining the benefits of "packaged" steam with the advantages of big boiler design, the versatile B&W Type FM Boiler is being selected for more and more foreign installations . . . is already serving a wide variety of domestic industries, utilities, and other users. FM Units having a total steam capacity of over 7,000,000 lb per hr are now in service or on order. Available in standard sizes for loads ranging between 2900 and 28,000 lb of steam per hr at pressures from 15 to 235 psi, B&W's "midget workhorse" is also obtainable for operation at higher pressures.

OTHER COST-SAVING FEATURES

- Saves Erection Time and Cost
- Meets Wide Range of Service
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Burns Oil and/or Gas
- Saves Fuel
- Saves Space

Write for Bulletin G-76 for full details about this unique, small boiler. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-627

BABCOCK & WILCOX

BOILER DIVISION

For more data circle 513 on Post Card

Here's POWER to clean tubes from 1/2" to 2" QUICKLY

Expanding scraper and replaceable element.

Expanding brush and replaceable element.

Sectional wire brush.

Air valve for one-man operation.

Rotojet Junior Tube Cleaners are unusually powerful for their size and weight. They are fed easily through the tubes with the operating hose, and can be shifted quickly from tube to tube. Their convenient size, speed, and ease of operation offer a marked contrast with external cleaners costing many times more.

An air valve directly behind the Rotojet motor permits one-man operation. Very little headroom is required, and either vertical or horizontal tubes can be cleaned.

Simplicity of Rotojet design and precision construction assure long service, efficient use of power, and freedom from trouble. Economical brushes, cutters, and scrapers meet practically any requirement.

Send for Bulletin J-410.

ROTOJET®

Junior TUBE CLEANERS

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Ave. Newark 1, N. J.

For more data circle 514 on Post Card

application information on safety and relief valves for liquid and gas service. Also presents vacuum breakers and vacuum regulators. Includes dimensions, service ranges. Also provided are liquid and air capacities, altitude-pressure-temperature table, and other data helpful in selecting proper valve. Associated Valve & Engineering Co.

. . . *Outstanding Among This Month's Catalogs*

145 Handbook on Demineralizing — Bulletin 5800, 39 pp, on treating water by demineralizing, explains principle of ion exchange. Discusses applications of many anion and cation exchange materials; series of curves help estimate cost of operation. Describes design and operation of demineralizer systems, multi-stage systems and mixed bed units. Includes curves of water quality obtainable. Cochrane Corp.

146 Communication Systems — Sixteen-pp Form P831 presents communication systems engineered for power plants. Advantages of such a system are given and photos show it in use in turbine rooms, boiler rooms, control rooms, laboratories and outdoors. Amplifiers, handsets, speakers, wall baffles, signal lights, switches and master control equipment incorporated in these systems are covered in detail. RCA Victor Div., Radio Corp. of America.

147 Corrosion, Abrasion Control — Modern practices and products for the positive protection of metal equipment from the effects of corrosion and abrasion are described in this 16-pp bulletin. Covers factory and field application of rubber or synthetic linings to metal parts or products, and maintenance coatings available for application by plant personnel. Also gives detailed information on accelerators, thinners, primers, curing and coverage. Goodall Rubber Co.

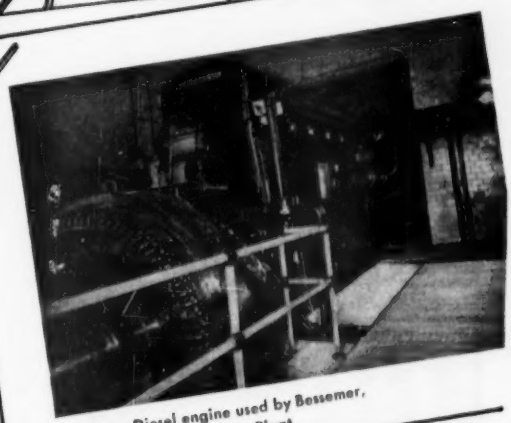
148 Why Power at Load Centers — Questions on selecting a load center unit substation to meet specific power requirements are answered in 20-pp Bulletin 11B6285B. Defines load center unit substations, tells how they can help improve low voltage caused by heavily loaded feeders, and how they can be placed indoors or outdoors near the load. Selection of proper equipment for a specific system is covered, also information on available types of transformers. Tells how this low voltage equipment gives good coordination and how components fit together into a compact unit. Size and dimension tables show space requirements and nomograms aid in selecting proper size breaker. Allis-Chalmers Mfg. Co.

HEATERS

149 Space Heater — Bulletin 550 describes company's Paraflo oil-fired, warm-air space heater, available in capacities of 200,000 and 250,000 Btu per hour. Stresses such special features as floating stainless steel combustion chamber, high operating efficiency, flexibility of mounting. Includes engineering design data, and lists types of structures suitable for Paraflo application. Dravo Corp.

*Could you make this report about your diesel engine?**

CITY OF BESSEMER, MICHIGAN REPORTS:



Nordberg Diesel engine used by Bessemer, Michigan Municipal Power Plant.

PISTONS PULLED AT 24,600 HOURS!

- All rings were free
- No carbon in ring grooves
- All original rings replaced in original grooves
- Rings should last at least 10,000 more hours
- Maximum cylinder wear was .004 at top, .002 at bottom

EXCELLENT

OIL CHANGE AT 5000 HOURS!

- No oil added to crankcase between changes
- Power cylinders fed at rate of 5 drops per minute
- Main bearing, rod bearings show very little wear
- Average K.W. per gallon of fuel is 13.5 @ 60% load factor

Sam Kalember

Superintendent,
Bessemer Light Utility.

Note:

FOR TOP ENGINE EFFICIENCY, BESSEMER RELIES ON:

Cities Service DC-930 Oil used for crankcase lubrication!

Cities Service DC-230 Oil used for power cylinder lubrication!

* Why not contact your nearest Cities Service Representative or write Cities Service Oil Company, Dept. A23, Sixty Wall Tower, New York City 5, New York.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

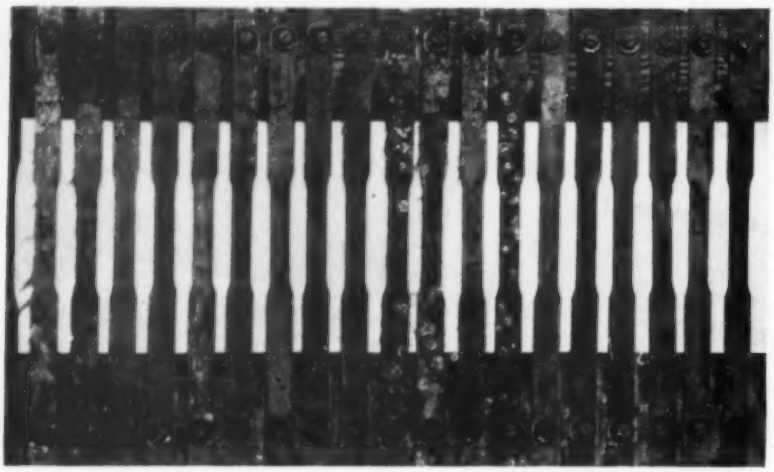
For more data circle 515 on Post Card

BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

Bridgeport Brass Co. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND. — IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



How various copper alloys respond toward biofouling in harbor water. The most corrosion resistant are the most affected by biofouling because of their solubility in sea water. This makes them less toxic to marine organisms, because their surfaces do not have a sufficient concentration of copper salts.

Good Cleaning Practices Increase Efficiency and Life of Tubes

The accumulation of foreign matter, such as slime, biofouling organisms, silt, cinders, and trash, lodging in condenser tubes, affect heat transfer and may lead to accelerated corrosion.

The problem of cleaning condenser and heat exchanger tubes and keeping them clean varies considerably from one plant to another.

In some plants rubber plugs have been found very satisfactory. The proper type and size depend upon the character of the silt or film to be removed. Rubber plugs, brushes, or scrapers usually are shot through the tubes by compressed air and water. The dumbbell type plug which has two wiping surfaces is quite popular.

Occasionally the cleaning implements are stopped by debris which may require "rodding." The best way to prevent debris from entering the tubes is by the proper use of strainers and screens.

Obstinate scales can often be dissolved by either inhibited acids or strong alkaline solutions which do not attack the tube itself. Chemical cleaning will be discussed in detail in a future Copper Alloy Bulletin.

Chlorination for Slime Prevention

A properly set up schedule of chlorination is very satisfactory for slime prevention. The chlorine concentration required varies with the character of the water. Over-chlorination should be avoided as it may injure the protective film and lead to accelerated corrosion. Generally, a red-brown or amber-colored film forms on the tube surface when the chlorination practice is satisfactory. This type of film is repeatedly found on tubes giving excellent results.

Excessive Chlorination Harmful

The resistance to corrosion from chlorinated waters varies with the alloy. Arsenical Admiralty (copper 70%, tin 1%, arsenic 0.03%, zinc remainder) and Muntz (copper 62%, zinc remainder) are not affected by mild chlorine solutions but may be severely attacked by strong ones. Aluminum Brass (copper 77%, aluminum 2%, arsenic 0.02%, zinc remainder) and Duronze IV, Aluminum Bronze (copper 94.25%, aluminum 5.5%, arsenic 0.25%) and the Cupro Nickel alloys are more resistant to chlorine solutions than the previously mentioned condenser tube alloys.

Biofouling Versus Corrosion Resistance

Biofouling of condenser tubes is associated with slowly moving sea water. In general, biofouling increases with the decrease in corrosion rate. Consequently, the high corrosion resisting alloys such as 70-30 Cupro Nickel (containing approximately 0.5% iron), Aluminum Brass and Durozone IV are highly susceptible to biofouling because of their low rates of solubility in sea water. The water film adjacent to the metal surface does not contain a sufficient concentration of copper salts to be toxic to marine organisms. Admiralty, Muntz, and Copper resist biofouling because of their higher solubility in sea water.

Biofouling organisms should be promptly removed from the tube surface by scrubbing with a stiff fiber brush and water. If the organisms are allowed to die and dry on the surface, considerable difficulty is experienced in removing those with calcareous bases such as barnacles. When not removed, such organisms and their decomposition products destroy the corrosion film and act as focal points for corrosion pitting. Decomposed organisms can lead to the formation of ammonia which may be followed by stress corrosion cracking of copper alloys with high zinc content.

Operation at a water velocity high enough to prevent organisms from attaching themselves is often helpful.

Technical Service Available

If you are contemplating retubing or are planning for new installations of condenser or heat exchanger tubing, consult the nearest Bridgeport sales office for technical help in selecting the alloy which will serve best for your particular operating conditions. Write on Company stationery for a copy of the 156-page Condenser and Heat Exchanger Tube Handbook. (965)

For more data circle 516 on Post Card

150 Direct-Fired Air Heaters — Illustrated in full color, 6-pp Bulletin 600-A explains the operation of cylindrical furnace heaters designed to deliver heated air at any specified temperature or pressure and offering flexibility of firing. Detailed flow diagrams show petroleum refining, spray drying, liquid reconcentrating, other applications. Peabody Engineering Corp.

OTHER EQUIPMENT

151 Improved Thawing Pits — Bulletin 1041, on prefabricated oil- or gas-fired thawing pits, shows how these pits solve the winter problem of thawing frozen railroad hopper cars of coal and other materials by means of radiant heat. Stresses faster thawing, low fuel consumption, other advantages. Gives specifications of a standard duty unit and pictures some installations. Hauck Mfg. Co.

152 Air Conditioning Plenum — This 16-pp booklet, based on research by Illinois Institute of Technology, answers questions on the use of the plenum above luminous ceilings for heating and/or ventilating. Booklet describes pressure loss, flow pattern, heat transfer, plenum supply and exhaust, together with additional material on sound absorption and acoustical characteristics. Luminous Ceilings, Inc.

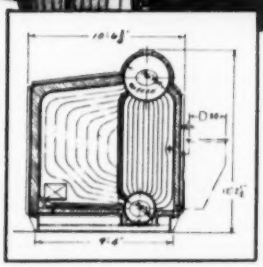
153 For Long Range Handling — In this brochure on long range handling machines, line drawings are utilized to show how the drag scraper, slickline cableway and tautline cableway operate. Pictures many types of equipment on the job and provides information on scraper storage, excavation and the use of scrapers with boom machines. Sauerman Bros., Inc.

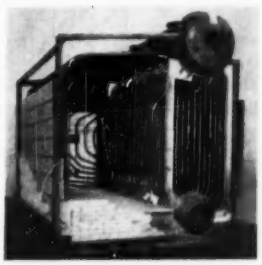
154 Oiling and Filtering Systems — Oiling and filtering systems for paper mill machinery described in Bulletin 14B, 8 pp, include gravity oil filter, pressure oil filter, sight feed valves, oil pumps, oil pressure and precipitation tanks. Describes pressure type filters and gravity systems. Wm. W. Nugent & Co., Inc.

Postage-free cards for ordering these catalogs are provided on pages 113-114. When using them, don't forget to include your job title and company name—even if you want those catalogs to be delivered to your home address

155 Silicone Facts — This attractively illustrated booklet presents some "fabulous facts" about silicone products. Cites performance of greases and lubricants, electrical insulation, water repellent finishes for textiles, silicone rubber, fluids for damping, masonry water repellents, defoamers and other products. Dow Corning Corp.

156 Zinc Anodes for Cathodic Protection — Recent expansion of the use of cathodic protection in underground and underwater installations has prompted this report on cathodic protection with zinc anodes. Approximately 40 pp, it offers a mass of engineering data and practical information on applications suitable for zinc anodes and desirable anode





Type H boiler in process of shop assembly.

Here's Bigelow's new, "one-piece" answer to a wide range of steam problems. This water-tube "packaged" boiler includes burner, forced-draft fan, feed water regulator, soot blower, valves, refractory, insulation, controls and accessory equipment. It is shipped complete—ready to operate as soon as service connections are made.

Advantages

Cuts Installation Costs and Time ... Requires Small Space ... Portable ... Simple To Operate ... Fast Steaming With Safety, Efficiency and Economy ... Low Maintenance ... Handles Quick Load Changes Easily and Efficiently ... Wide Range Of Service ... Burns Oil or Gas.

Available in standard sizes for capacities ranging from 8,000 to 30,000 lbs. of steam per hr. Write for complete catalog.

THE BIGELOW COMPANY • NEW HAVEN 3, CONN.

BIGELOW REPRESENTATIVES: Boston • New York • Chicago • Philadelphia • Syracuse • Detroit • Atlanta • Milwaukee • New Orleans • Petersburg, Va. • Washington, D.C. • San Francisco • Los Angeles • Seattle • Knoxville.

For more data circle 517 on Post Card

GARLOCK Service-Tested
LEATHER PACKINGS

Available in ALL SHAPES, ALL SIZES, ALL TANNAGES and ALL TREATMENTS

GARLOCK's modern, completely equipped leather packing manufacturing plant has the facilities to furnish *all types* of leather packings. This plant maintains the same high standards of materials, design, workmanship, and inspection that Garlock has upheld for the past 66 years in the manufacture of mechanical packings.

SHAPES

Molded Cups **"U" Packings**
"V" Packings **Washers** **Gaskets**
Discs **Flange or Hat Packings**

SIZES

All sizes suitable for leather packing applications from 1/8" O.D. (such as leather washers for needle valves) to 99" O.D. (such as large "U" packings for heavy duty hydraulic service).

TANNAGES

Oak **Chrome** **BITAN***
Garlock Bitan combines the heat and oil-resisting qualities of chrome with the fine grain, non-porous, strong qualities of oak.

TREATMENTS

Oil, grease, or wax treated (and combinations of these impregnants)—in degrees of hardness from extremely soft and flexible to very hard and rigid.

Synthetic rubber impregnated—combines the high tensile strength of leather and elasticity of rubber, and gives greater temperature resistance.

With fabric liners.
Untreated—for certain low pressure water applications.

Put your leather packing problems up to Garlock. Contact your Garlock representative or write for leather packing folder today. *Registered Trademark

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

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GARLOCK
PACKINGS, GASKETS, OIL SEALS
MECHANICAL SEALS
RUBBER EXPANSION JOINTS

For more data circle 555 on Post Card

forms and methods of application. Applications covered include steel distribution piping systems, transmission pipelines, heat exchangers and condensers, others. The American Zinc Institute.

157 Copper Water Tube — Sixteen-pp Bulletin BC-1 gives application, dimensional information on three types of company's copper water tubes. Discusses packaging and soldering. Technical section gives design and installation data. Brass and Copper Tube Div., Triangle Conduit & Cable Co., Inc.

158 Heat Transfer Tables — Now available to qualified power engineers is a 44-pp book of heat transfer tables. They were prepared to provide a quick and reasonably accurate means of estimating amount of heat transfer surface required in the heat exchangers, coolers and condensers of a chemical processing or oil refining plant. They are said to serve equally well in predicting performance of available equipment under new or changed conditions. Alco Products Div., American Locomotive Co.

159 Pressure Equipment — Twelve-pp Catalog 400 covers manufacturer's line of separators, exhaust heads, traps and strainers, and boiler trimmings. This new catalog condenses the information given in three other catalogs (each on a particular class of equipment) and it gives adequate size and pressure tables and technical data on the most frequently used equipment. Wright-Austin Co.

160 Single Stage Turbine — Six-pp Bulletin 4206 contains design features, dimensions and performance data on the HCB single stage turbine with maximum operating conditions of pressures to 300 psig, temperature to 550 F, and speed to 4000 rpm. Presents two-pp cutaway diagram of turbine listing 18 design features. De Laval Steam Turbine Co.

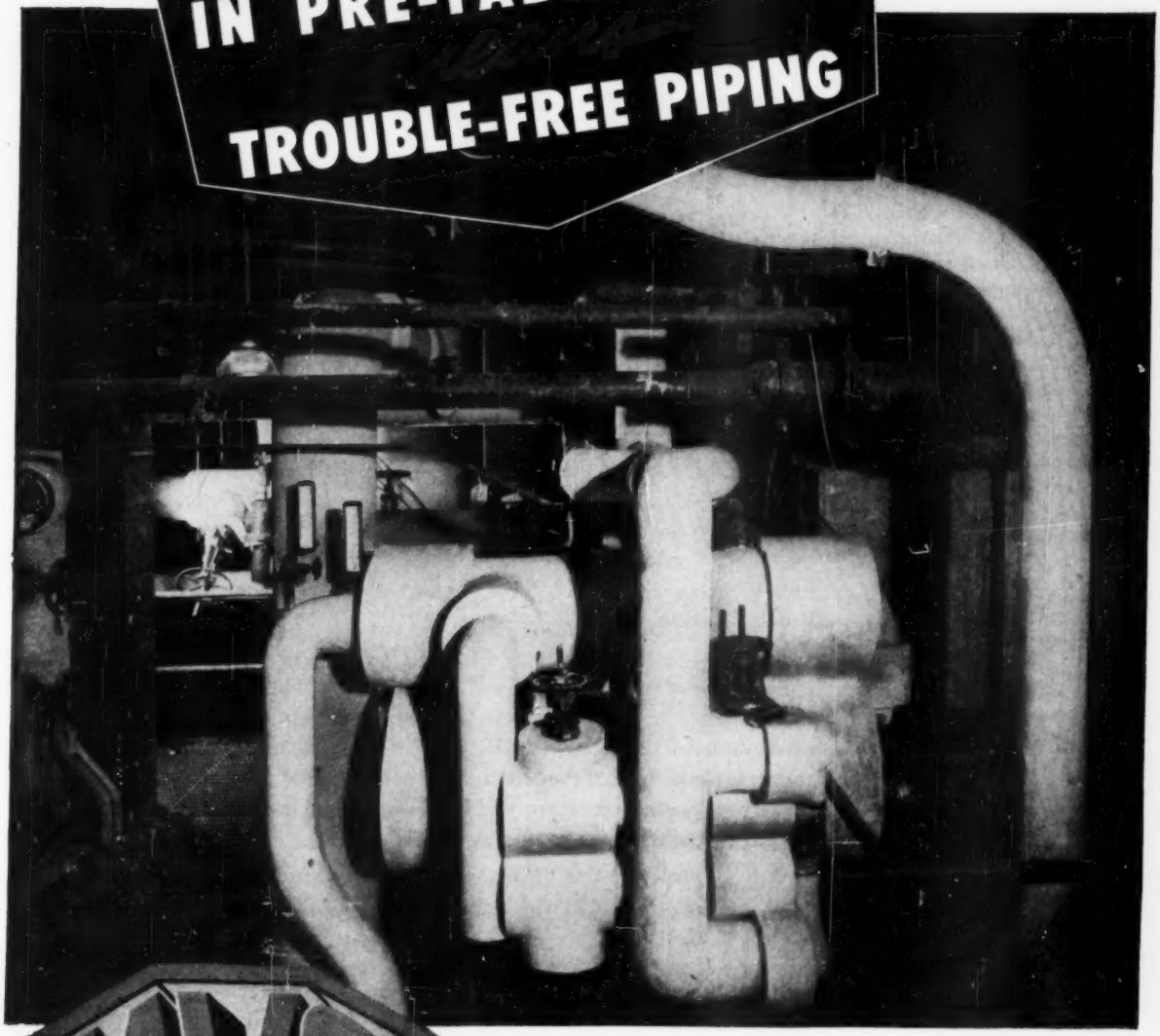
161 Vaneaxial Blowers — Direct-drive vaneaxial blowers, three types of belt-drive blowers and a portable blower for exhausting fumes from tanks are described in 16-pp Bulletin A-110. Includes dimension drawings and figures, also complete air delivery tables. Hartzell Propeller Fan Co.

162 ABC's of Dryness — Eight-pp Bulletin 16.0.081 presents packaged dehydration units for efficient drying of air or other gases. Tells what these dryers can do, what they will remove dryness from and where they are used. Explains drying operation; discusses adsorbents and equipment utilized, giving construction details and sizes offered. Typical arrangements for both full-stream and split-stream reactivation are diagrammed, and selection information included. Equipment Div., J. F. Pritchard & Co.

163 Water Hose — This illustrated bulletin illustrates several types of water hose and gives sizes, working pressures and weights. Includes construction details, lengths, couplings and applications for general water service and other medium and low pressure use. Quaker Rubber Corp., Div., H. K. Porter Co., Inc.

164 Rotary Pressure Joint — Bulletin 5080 gives information on correct installation of rotary steam joints, which serve as pipe union between revolving steam drums or tilting kettles and stationary pipeline. Important requirements are emphasized, and six drawings show right and wrong installations. Seamlex Co., Inc.

NAVCO ACCURACY IN PRE-FABRICATION TROUBLE-FREE PIPING



NAVCO

Prefabrication accuracy is an essential "MUST" to assure a proper fit and economical operation. Navco's 40 years' experience in fabricating assemblies in all sizes and for all operating conditions is your assurance of such accuracy.

Consult Navco for your next piping job.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

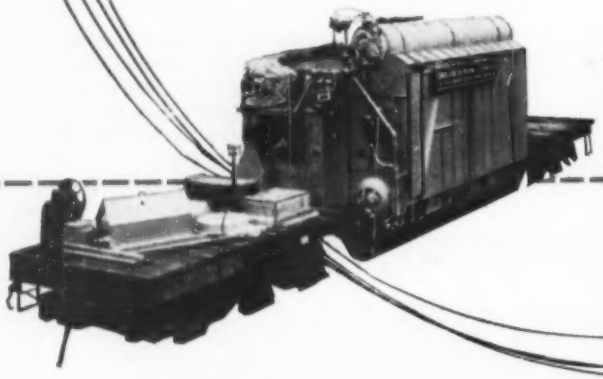
For more data circle 519 on Post Card

Who's buying VP boilers?

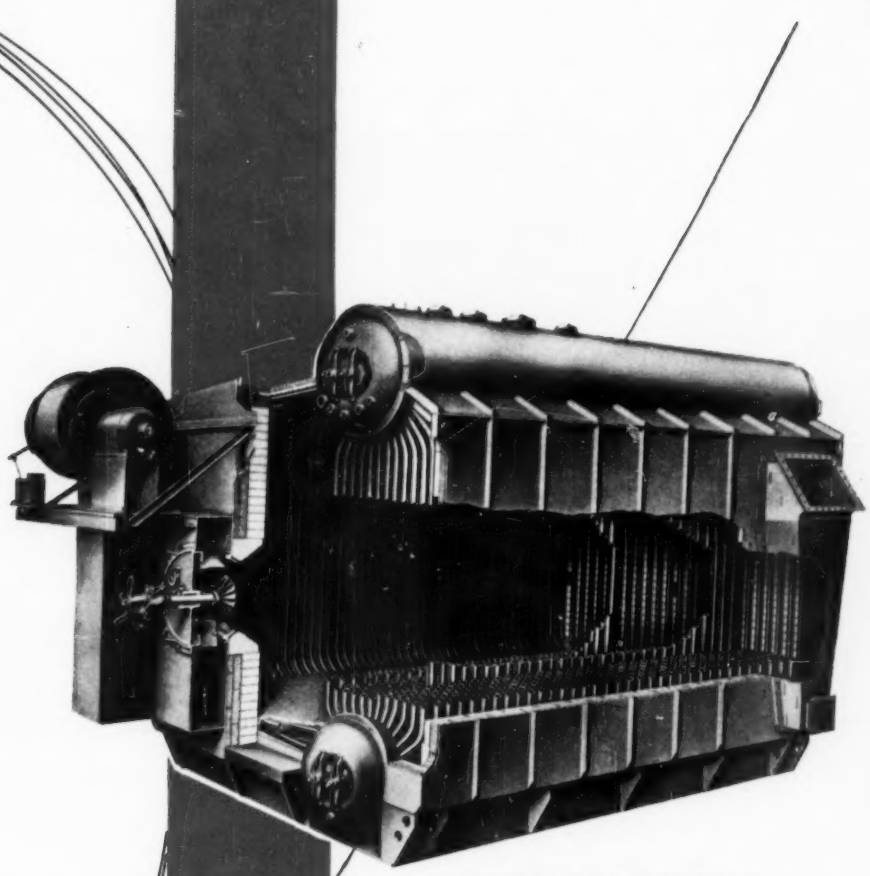
A quick perusal of the list on the opposite page indicates that, varietywise, almost everyone is. Big companies and small companies representing many industries . . . chemical, paper, textile, petroleum, foods, metals, etc. — utilities, hospitals — even the Atomic Energy Commission — have purchased one or more C-E Package Boilers, Type VP.

There's significance in that fact for you. It's quite likely that all of these buyers knew that there are many "package" boilers on the market. They probably knew, too, that most of them *look* pretty much alike. But they *bought* the VP — the package boiler with *extra* features. Could be that they liked the idea, too, of buying a *small* boiler from the same company that has designed and built many of the *largest* boilers in the world.

Why not look into this VP Boiler and its *extra* features? Let us send you Catalog VP 103 which describes it in detail. B-712



C-E



RECENT PURCHASERS OF VP BOILERS

Aceitera "La Gloria", S.A.
Albemarle Paper Co.
American Bitumuls & Asphalt Co.
American Woolen Co.
Ames Textile Corp.
Anaconda Aluminum Co.
Ashland Oil & Refining Co., Inc., The
Bell Telephone Laboratories, Inc.
Cardinal Glennon Memorial Hospital
Central of Georgia Railway Co.
Colonial Print Works, Inc.
Commonwealth Edison Co.
Comp. Hulera Euzkadi, S.A.
Container Corp. of America
Du Pont de Nemours & Co., Inc., E.I.
Federal Sweets & Biscuit Co., Inc.
Ferro Stamping Machine
Gaylord Container Corp.
General Motors Interamerica Corp.
Hockmeyer Brothers, Inc.
Liquid Carbonic Corp.
Marinette Paper Co.
Mathieson Chemical Corp.
Mead Corp., The
New York Life Insurance Co.
Omaha Public Power District
Orangeburg Manufacturing Co.
Pan American Refining Corp.
Ponce Hospital Center
Smith, Inc., J. Howard
Southern Cotton Oil Co.
Standard Oil Co. of British Columbia
Sure-Seal Corp., The
U. S. Atomic Energy Commission
Waterfalls Tissue Corp.
Whitaker Cable Corp.

SPECIFICATIONS — VP BOILER

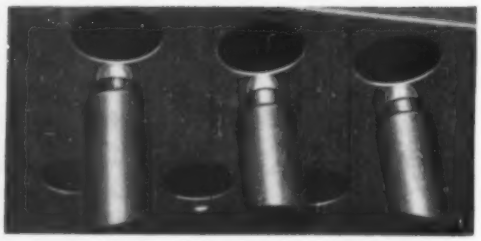
Capacity	4,000 to 30,000 pounds of steam per hour
Pressures	Up to 250 pounds per square inch
Temperature	No superheat
Fuel	Oil or gas
Erection	Completely shop-assembled
Foundation	Simple concrete slab

COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

BOILERS, FUEL BURNING AND RELATED EQUIPMENT; PULVERIZERS; AIR SEPARATORS AND FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

For more data circle 520 on Post Card



With G-E vertical lift, you can see when the breaker disconnects

Maximum safety to operator and equipment is provided. Mechanically operated shutters of insulating material close off disconnect openings when breaker is lowered. Stationary contacts are never exposed, present no safety hazard. Shutters open as breaker is raised, permitting entrance of breaker studs.

On G-E Metal-clad Switchgear—

New safer, fast-action elevating mechanism can raise or lower breaker in 30 seconds

Vertical-lift design isolates breaker, simplifies inspection

Smooth, practically effortless raising or lowering of the breaker in General Electric's improved metal-clad switchgear, whether for inspection or test . . .

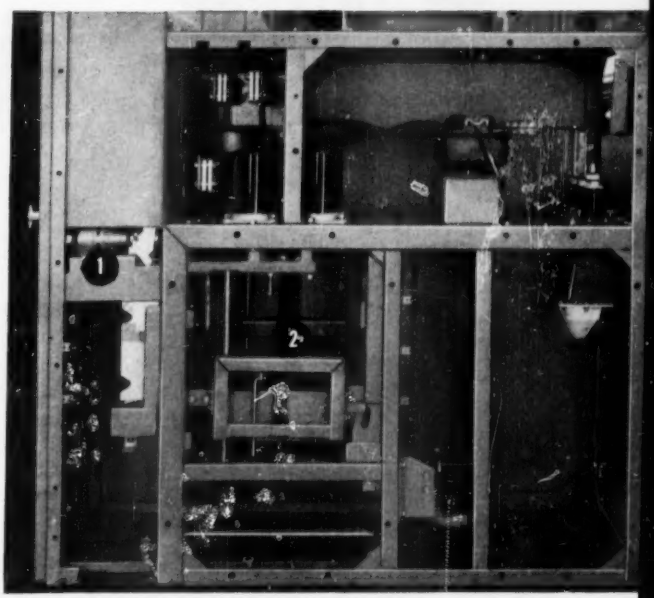
That is what you get with one of the simplest elevating mechanisms possible for the job: two jack screws—a sturdy cross chain drive—a compact gear motor with operating switches.

POSITIVE-ACTING MECHANICAL INTERLOCKS assure speedier operation. An interlocking system effectively blocks raising or lowering a "closed" breaker. In the operating position, the circuit breaker is locked in, preventing downward movement caused by even the most severe vibration. All parts of the elevating mechanism are accessible at front of the compartment, with the motor easily demountable for hand-crank operation.

BESIDES THESE ADVANTAGES of the new, faster-acting breaker-elevating mechanism, you also get full benefits of G.E.'s basic vertical-lift design. You can—

- See when breaker is isolated and breaker studs separated from main stationary contacts. Mechanically operated shutters close off disconnect openings to protect operator.
- Close the door with breaker in lowered position.
- Make most inspections and tests with breaker just lowered—not removed from compartment.
- Save time and energy, as mechanical lift makes removal of breakers convenient and easy.
- Gain quick, easy access to breakers in outdoor installations—especially on roofs where catwalks make other types of breaker removal inconvenient.

FOR THE COMPLETE STORY on G-E Vertical-lift Metal-clad switchgear, with ratings up to 13.8 kv, 500 mva, write for GEA-5664-A, Sect. 874-4, General Electric Company, Schenectady 5, N. Y.



NEW ELEVATING MECHANISM is shown in breaker with side plates removed. Compact gear-motor (1) in front of the compartment drives simplified jack screw mechanism (2) to raise breaker.

VERTICAL-LIFT DESIGN proves invaluable in outdoor switchgear installations—enables personnel to disconnect and inspect breakers easily in spite of gravel or other obstacles.

You can put your confidence in—

GENERAL ELECTRIC

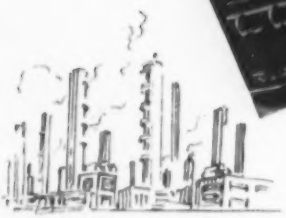
THIS 400,000 Pounds per HOUR

Vogt

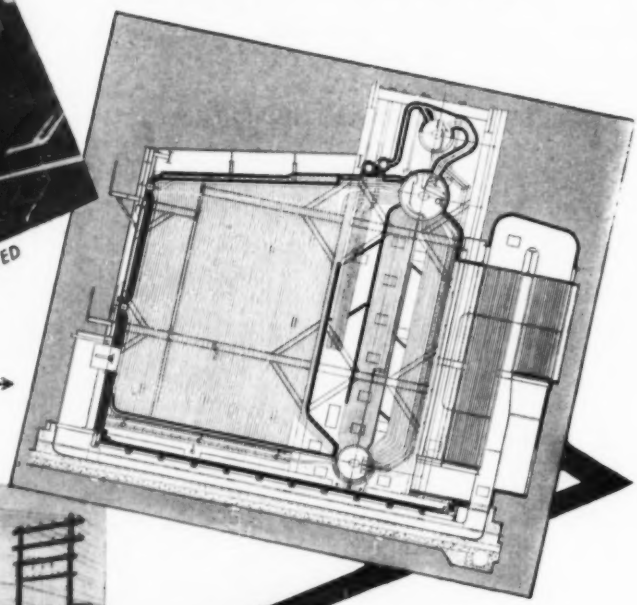
STEAM GENERATOR

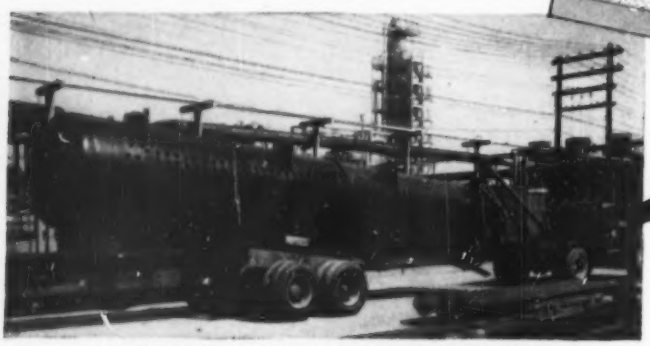
Gives Top Performance in a Leading Texas Petroleum Refinery

VIEW OF THE COMPLETED STEAM GENERATOR



RIGHT → LONGITUDINAL SECTION THROUGH THE UNIT.





6'-6" DIAMETER x 37'-0" LONG STEAM DRUM BEING TRANSPORTED TO THE ERECTION SITE DURING INSTALLATION.

PRINCIPAL DATA

400,000 pounds per hour capacity.

Fusion welded steam and water drums designed for 700 lbs. S.W.P.

Superheater delivers steam at 750°F. total temperature.

Water cooled furnace.

Burners for Oil and Acid Sludge fuel.

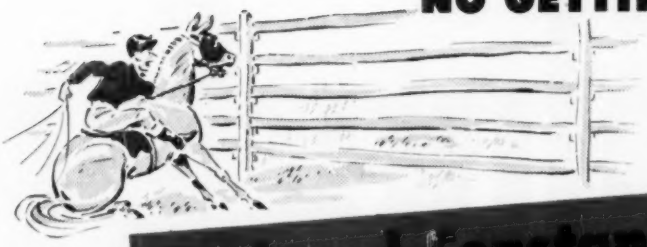
Vogt builds a complete line of bent tube steam generators designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Write for bulletins.

HENRY VOGT MACHINE CO., LOUISVILLE 10, KY.

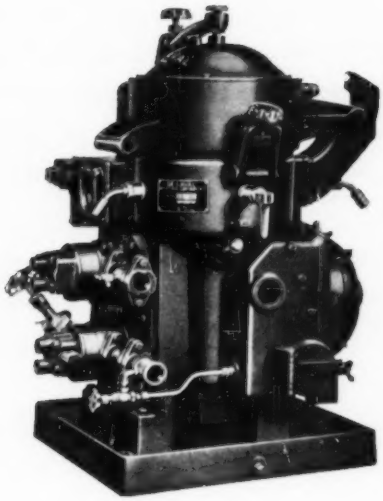
BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.

For more data circle 522 on Post Card

NO GETTING AROUND IT!



De Laval Constant Efficiency Bowl Gives You Better, Safer Purification



A De Laval Oil Purifier gets rid of ***both*** contaminants that ruin the usefulness of lubricating oil. The Purifier puts centrifugal force to work to throw out of the oil both solid impurities and water, and thus maintain the oil in a condition best compared with that of new oil.

The manner in which purification takes place within a De Laval is important. The efficiency of purification is constant, from the moment a run starts until the bowl is full of dirt and must be stopped for cleaning. This "constant efficiency" is an inherent advantage of De Laval bowl design. Purification takes place between the discs, whereas dirt thrown out of the oil is stored outside of the zone in which purification takes place. Once it is centrifuged out of the oil, dirt can neither recontaminate the oil nor affect the degree of purification.

You can ***rely*** on De Laval constant efficiency purification.

DE LAVAL

THE DE LAVAL SEPARATOR COMPANY
Chicago POUGHKEEPSIE, N.Y. San Francisco

for more dependable power production

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full value for

MEASURED by any set of standards, every system of Hagan Automatic Control and Instrumentation returns full value for every dollar of cost. This is because each system, regardless of size, type or operating conditions, starts immediately to pay dividends in fuel savings, improved operation and accurate records.

Hagan makes sure you will get full value by designing each component for ease of calibration, accurate and dependable operation, and versatility of application. Then each unit of a system is selected especially for the function to be handled, and for proper correlation into the whole system.

A review of the successful applications of Hagan Automatic Controls and Ring Balance Instruments, listed on the opposite page, is convincing evidence of the competence of Hagan Engineers. You are invited to avail yourself of the experience gained by our staff in thirty-five years of service to the industrial and utility power plant field.

HAGAN
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CALGON

every dollar!

- Control of combustion rate of boilers
- Constant or graduated draft control
- Constant or graduated pressure control
- Control of single or multiple fuel firing
- Speed control of fans or pumps
- Hydraulic coupling control from speed or delivery of driven unit
- Control of steam, gas and liquid pressures
- Accurate control of position from remote points
- Differential pressure control for liquids or gases
- Boiler drum water level control
- Steam pressure reducing and desuperheating control
- Superheated steam temperature control
- Feed water heater pressure and temperature control
- Control of pump discharge pressure and flow
- Steam jet refrigeration control
- Removal of oil, moisture and solids from exhaust steam
- Recovery of steam from continuous blowdown systems
- Single element meters for measuring differentials and indicating, recording and integrating in units of flow
- Dual element meters for simultaneous records of two flows in a single meter case
- Pressure, temperature and draft recorders
- Differential pressure recorders
- Absolute pressure recorders
- Automatic compensation for single element meters, to correct readings for variations in pressure, temperature, density, gravity and other measurable factors
- Automatic addition or subtraction of two flow rates
- Pneumatic and electric signal transmitters, as standard attachments
- Liquid level recording and control
- Flow ratio control
- Fixed or adjustable speed program control
- Mass flow recording
- Oxygen flow recording
- Wide range flow metering systems

Hagan Corporation

HAGAN BUILDING PITTSBURGH 30, PENNSYLVANIA

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
CONTROL SYSTEMS FOR AUTOMOTIVE AND AERONAUTICAL TESTING FACILITIES

For more data circle 524 on Post Card

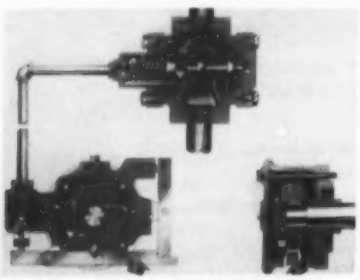
EQUIPMENT NEWS

Described here are recently announced products and processes. To request more information from the manufacturers, use Reader Service Cards on page 113

1—SAFETY STOP VALVE is designed for steam turbines

A new excess speed safety stop valve is announced for this company's line of steam turbines. The improved stop valve is designed to function independently of the constant speed governor and to eliminate levers between safety trip mechanism and shut-off valve. The valve stem doesn't protrude outside the valve body, a new design feature intended to prevent stickiness due to boiler compound or other foreign matter in the steam. Complete enclosure of the valve eliminates accidental damage from outside, manufacturer points out, and the new valve can be incorporated in the old style valve bodies.

As illustrated, when the turbine is operating, Lever C is horizontal, Pilot



Valve D is closed and Valve A is held open by Spring E. When excess speed is reached, centrifugal force throws Weight B against Lever C, opening Pilot Valve D. This relieves pressure back of Valve A, unbalancing and closing it, compressing Spring E and shutting off the steam supply to the turbine. When Lever C is manually reset, Pilot Valve D closes, allowing pressure to build back of Valve A and thus restoring the balance. Spring E then opens the valve, admitting steam to turbine. Coppus Engineering Corp.

2—MULTI-PORT VALVE for use in water treatment systems

For automatic regeneration cycle control of water softener, filter and ion-exchanger systems, use of this new 2-in. multi-port valve is said to result in longer life from treatment media as well as lower installation and maintenance costs. Regulated by automatic electrical controls and operated by time clock, the entire regeneration cycle can be accomplished without supervision during off-work hours, it is claimed; or, two or more systems can be coordinated for a constant supply of treated water.

Regeneration cycles can be precisely controlled, says manufacturer, and, once-adjusted to local water conditions the cycles do not vary. Lower installation costs are attributed to the fact that the one simplified valve is designed to handle the entire system, and this means less piping and a quicker installation. Automatic Pump & Softener Corp.

3—D-C INSULATION TESTER for apparatus maintenance use

A high-voltage portable insulation tester for use in non-destructive testing of electrical apparatus operates on a 115-v, 60-cycle supply to provide adjustable test voltages from 1 to 15 kv. It measures d-c insulation resistances up to 30,000 megohms.

The instrument has a microammeter for measuring d-c leakage current through the insulation being tested and a meter for indicating voltage across the insulation. Two current ranges, 0 to 50 and 0 to 1000 microamperes, are provided. A calibration curve of d-c resistance in megohms vs d-c leakage current in microamperes at 15 kv is mounted on the instrument panel. Curves of maximum allowable conduction current vs temperature are available with the tester to indicate insulation serviceability. Line Material Co.

4—CABLE SPLICE TAPE is waterproof, long wearing

Introduced several years ago to the communications field, this cable splice rubber tape is now available to the utility, power and industrial fields. Important features announced for it are imperviousness to copper through special blending; 19,000-v dielectric strength; acid resistance, and anti-corrosive effect. The tape is claimed completely waterproof and to have extreme cohesive properties — the latter makes it possible to apply the tape lengthwise by pinching. Many wire splice jobs can thus be handled without winding, it is noted.

According to manufacturer, this tape affords high safety and wear rating for electrical and general purpose use; it has an elongation factor of 600 per cent and a tensile strength of over 19 lb per in. width. It comes foil wrapped in ¾-in. and 2-in. 15-ft rolls. Specifications and sample are offered. CSI Sales Co.

5—MINIATURE VENTURI TUBE meters small quantity fluids

Designed for measuring gaseous or liquid fluids in quantities too small for application of a normal size venturi or orifice, the Type TF Venturi is furnished in six inlet sizes from ½ to 2 in.; there being four different ratios of throat to main in each of these sizes. When this tube is to be installed directly into the pipeline, no supplemental approach or downstream pipe section is provided. When the pipeline is of other than the selected standard ratio venturi, however, attention to the conditions of approach is declared necessary.

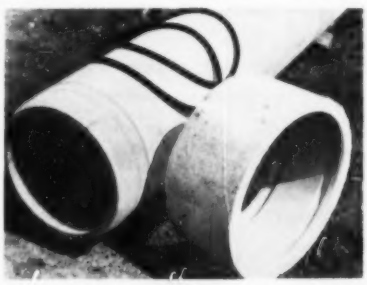
Component parts of the tube are welded together to form a completely integrated assembly. It is furnished with annular pressure equalizing rings at the point where main and throat taps are located. Although usually equipped with flanged ends, the unit may be provided with screwed ends for sleeve couplings. The tube is made of cast iron, stainless steel or bronze, to suit the fluid measured. Secondary instruments for use with these devices include manometers, also inferential meters of the indicating, recording and totalizing types. Simplex Valve & Meter Co.

6—GEAR MOTOR for use in hazardous locations

For places where dangerous fumes, inflammable gases, explosive substances or combustible dusts may exist, this right-angle Syncrogear with explosion-proof motor is announced. Available in 1 hp rating with speeds from 45 to 155 rpm, this three-phase a-c motor, the Type SESV-GW, is designed to comply with UL specifications for Class I, Group D, and Class II, Groups F and G service. It embodies splash lubrication, a hardened and ground worm, normalized castings and asbestos-protected windings. Like other gear motors in this company's Syncrogear this incorporates a cantilever design to protect gear alignment. Detailed information is offered. U. S. Electrical Motors Inc.

7—COUPLING for use with Transite pressure pipe

Ring-Tite is a new coupling reported to cut down expected installation time of Transite pressure pipe because it automatically centers, aligns and provides for expansion. It consists of a sleeve and two rubber rings, the sleeve having two grooves cut circumferentially into the inner wall to locate the rings and hold them in position. To go with this sleeve, the ends of the pipe are machined to provide an entering taper back of which

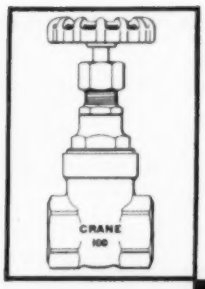


is a two-step machined area. The shoulder between the two steps provides a stop which halts movement as the pipe, rubber rings and Transite sleeve slide together.

When the rubber rings contact the stop shoulder the assembly is completed. The rings are equidistant on either side of the joint, it is noted, and expansion space has been left between pipe ends. The lengths, being joined, are in alignment, and the rubber rings are compressed between sleeve and pipe.

In making the assembly, you first

NEW* brass gate valves by CRANE



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100-Pound

No. 438,
125-Pound

No. 437,
150-Pound

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for 3 All-Time CRANE *favorites*

Here are valves that didn't have to be changed . . . because each has long been the best in its class. But Crane found ways of improvement to give you an even better buy for your brass valve dollars.

For example—here is greater strength, greater rigidity, made possible by the new cylindrical upper body . . . the same basic shape as high-pressure steel valves. Here, too, is an improved stuffing box that screws *into* the bonnet—also better stem support to assure truer alignment and minimize wear on the packing.

And not to be overlooked is their clean, modern appearance—a very desirable advantage for all of your "exposed" installations. Sizes ¼ to 3 in. Ask your Crane Representative all about this improved brass valve line next time he calls.

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For more data circle 525 on Post Card

pop the rings into their grooves. Next, spread the pipe ends with a lubricant, align the pipe roughly, attach the puller, and finish with an easy pull. According to company, this may be done under water, in any temperature, in the rain or in mucky conditions. Also the pipe may be laid in a deflected position when lines must be on a curve. Johns-Manville.

8—SECTIONALIZER, oil filled, is a higher rated unit

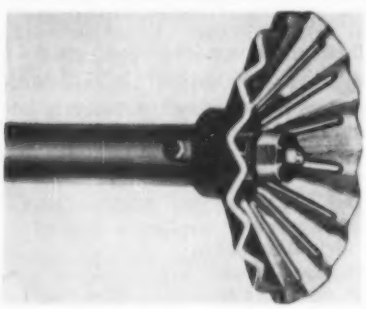
The Type GRS is a new 140-amp automatic feeder line sectionalizer for use with reclosing breakers and large distribution reclosers. It is described as a series connected device that counts pulses of fault current created by opening and closing of the automatic circuit breaker, and isolates the feeder line after a preset number of counts.

This new model extends the use of sectionalizers to higher capacity feeder circuits and makes the unit more adaptable to use with reclosing circuit breakers and large oil reclosers. Manufacturer of this oil-filled unit says it can be safely used to break load currents up to 220 amp, and that it will operate 2000 to 5000 times without maintenance, if necessary. Also, it is trip free and can be set to trip open after one, two or three operations at or above 220 amp. Application on distribution circuits up to 15,000 v is reported by manufacturer. Westinghouse Electric Corp.

9—BURNER TIPS designed for extra long service

Tests on Illium burner tips are reported to show that on many applications they outlast steel and other materials at least 10 times. Originally designed for use in petroleum refineries, they are said to perform well in fireboxes where cracked gasoline sludge is burned and in standard design oil refinery furnaces. They afford long-run economy through durability and elimination of costly downtime of the burners, according to manufacturer.

Tips are cast of Illium G, a high



chrome-nickel alloy with exceptional resistance to heat, erosion and corrosion from sulfuric, phosphoric, nitric and mixed acids of many types and concentrations. Described as easily cleaned, they come in many shapes and designs. The Illium Corp.

10—SPRAYED MOLYBDENUM serves in new applications

The use of Sprabond Wire, described as essentially pure molybdenum in a form suitable for metallizing use, is reported to have expanded rapidly since its introduction about four years ago. Then, it was intended primarily as a bonding coat material to simplify and speed surface preparation for most normal metallizing applications and permit the development of high strength bonds where required.

Since then, applications involving use of this metallizing material for building up wearing surfaces have increased. Sprabond is claimed to have high resistance to wear when running against bronzes, and thus to increase the life of the bronze mating surfaces. Applications involving babbitt or other white metal bearings are in successful service, company reports. Another promising field for this Sprabond Wire surfacing is said to lie in abrasive wear where shock or impact is not excessive — as in forming dies, mandrels or pulleys running under abrasive conditions. Other interesting applications of Sprabond are described in Bulletin 57C. Metallizing Engineering Co., Inc.

11—ELECTRONIC TELEPHONE is designed to lick noise

For noise-free communication in noisy areas, the Gai-Phone (pronounced "guy phone") is designed to let the user carry on a clear conversation without leaving his desk or post. It requires no acoustical booth or other enclosure. The Gai-Phone is similar in appearance and operation to a conventional telephone, says manufacturer, and it can be installed and mixed with conventional telephones in the same system. And because its maximum output is no greater than that of a conventional telephone, it can be used wherever such a telephone would be used, it is explained.

Use of a special close-talking, dynamic transmitter in the Gai-Phone handset is said to result in both clear transmission of the user's voice and clear reception under noisy conditions. The phone is said to control both incoming volume level and outgoing level; thus it can be adjusted for best operation in individual locations. Another feature claimed for the Gai-Phone is controlled automatic elimination of "side tone," advantageous in noisy spots because it reduces to below audibility the amount of noise that is picked up on the transmitter and fed to the receiver in the same handset. Gai-Tronics Corp.

12—PULL-TYPE SPREADER for industrial area ice control

The Model SC-52 is small and convenient for ice-proofing walks, driveways, loading platforms and other locations. It can be attached to any truck without changes, manufacturer reports, and it spreads a fine or heavy coating of salt, sand, cinders and other skid-proofing materials. Self-powered by its own traction, this spreader is designed to cover a 360-deg spread under the truck wheels. The unit includes a tow hitch for attachment to truck. Bulletin A-371 describes the unit. Baughman Mfg. Co.

13—WIRE STRIPPER with interchangeable cutters

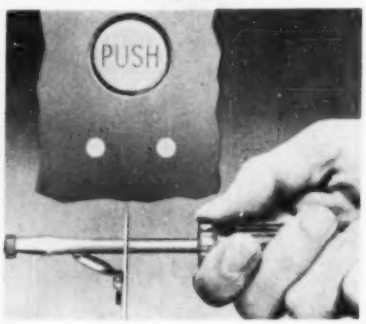
Interchangeable cutters, for stripping 12- to 24-gage solid or stranded wire, or 300 ohm twin lead-in wire, are a feature of the Whiz Wire Stripper. It weighs only 12 oz and has a lock-open feature that holds the jaws open automatically so the wire can be removed

after stripping without crushing. The jaws are released instantly with a finger tip touch of the lower handle, it is said, making it unnecessary to shift the grip on the tool while resetting. This feature suggests its use as a production line tool as well as for general shop use.

The tool has hardened steel cutters that are replaced by removing two screws. Four extrusions, two for each blade, hold them in alignment. The Whiz Wire Stripper has a rust-resistant black oxide finish, sells for less than $4.00. Extra blades are priced at 75 cents per pair. Rockford Wire Stripper Co.

14—ACCESS DOOR is low cost, spring-hinged unit

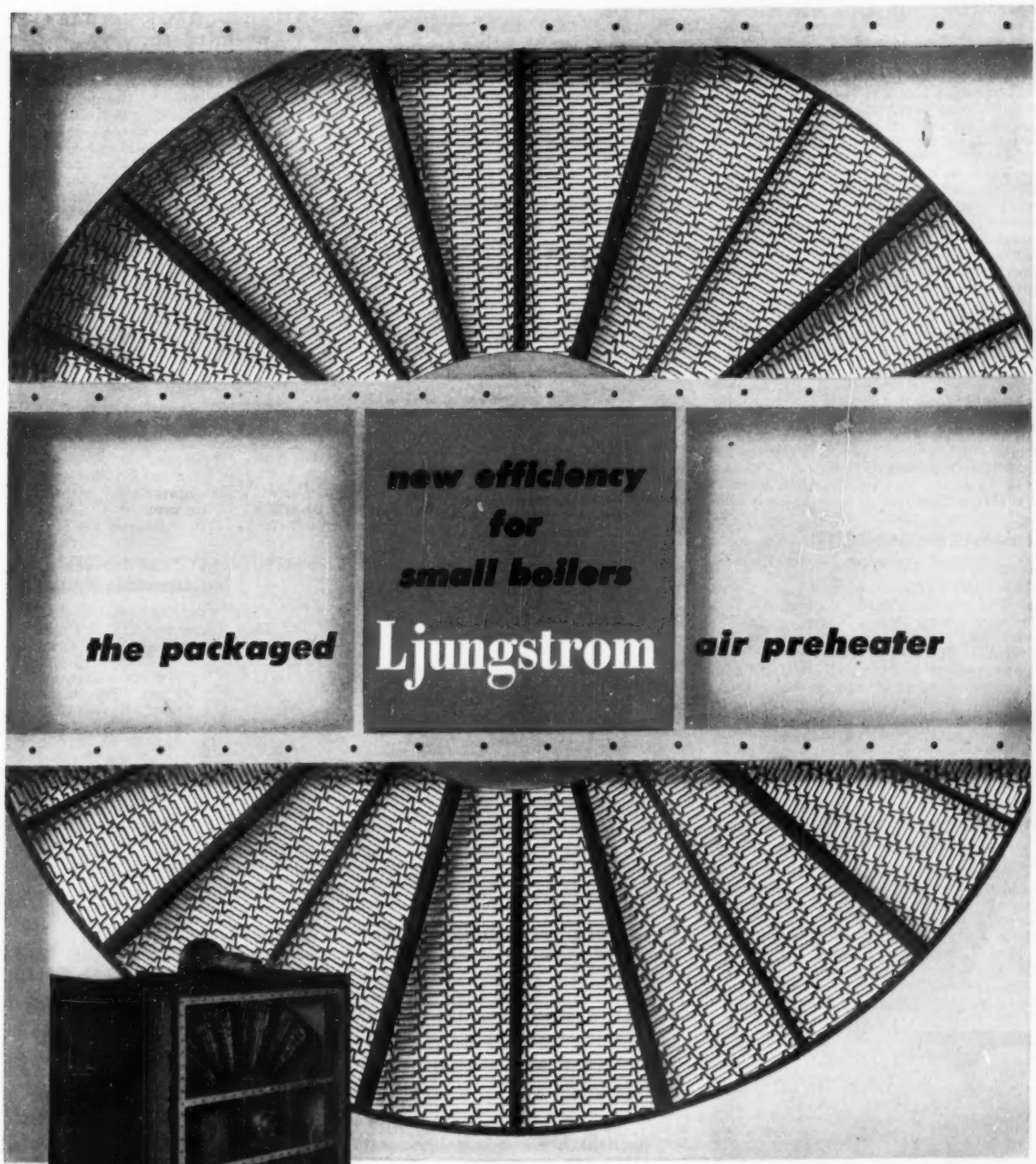
Designed for use where a flush finished surface is essential, the Model KM-713 has a "captive" door that cannot sepa-



rate from the surrounding panel, company states. It is mounted by rivets, after drilling two rivet holes and a hole for the door opening. This access door is recommended for use where frequent adjustments are made by screw drivers or similar tools and for lubricating points. It opens by pushing the door with the tool — the door springs back into place when the tool is withdrawn. A ¾-in. dia size is standard, but special sizes can be produced. Camloc Fastener Corp.

15—ANNUNCIATOR analyzes the cause of shut-down

An annunciator system which automatically indicates the sequence of off-normal alarms is announced in the Visual Sequence Annunciator. It is suggested for use where alarms are applied to closely inter-related variables. In most of these applications, if any one variable goes off normal, the process shuts



Even boilers as small as 25,000 pounds of steam per hour — can now operate at fuel efficiencies you never dreamed of. With the new *Packaged Ljungstrom*, you can apply the principles of heat recovery universally used in large utilities. The Packaged Ljungstrom Air Preheater operates on the *continuous regenerative counterflow* principle. Waste heat in products of combustion is absorbed on specially designed surfaces in the slowly rotating rotor. As the surfaces enter the stream of incoming combustion air, they transfer their heat to this air. The entire unit is self-contained as you receive it. For more detailed information – get in touch today with The Air Preheater Corporation.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

For more data circle 526 on Post Card

down. Thus, with some annunciators it is difficult to determine which variable first went off normal.

Sequence indicating annunciators are designed to pinpoint the cause of trouble by indicating the first variable to go off normal — by automatic lock-out of subsequent signals, or by causing the first signal to be red and subsequent signals white. A pushbutton reset feature is also available to cause the sequence indication to start over again. In addition to use in compressors and process applications where the cause of trouble is sought, sequential annunciators are declared advantageous on dangerous processes where operators want to be sure the entire process has shut down.

Alarm signals are grouped for sequential lock-out by simple jumper connection on the rear terminal block, and any number of inter-related groups may be formed or inter-changed as desired. Contacts, relays and other moving parts are within hermetically sealed plug-in units. Thus, additional signals may be added by adding plug-in units to the common chassis, it is pointed out, and the entire system is reported suitable for installation in Class 1, Division 2 locations. Panalarm Products, Inc.

16—WIRE CONNECTOR, screw-on type, is all plastic

This wire connector with one-piece molded plastic threads is designed for low-cost connections of No. 14, 16 and 18 wire, and is available in two sizes, A-1 and A-3. The plastic used in these connectors offers high impact strength for mechanical security and is impervious to most chemicals, says company, and the smooth threads grip wires securely without cutting of wire strands. The connectors are green in color, designed to withstand temperatures to 400 F. Ideal Industries, Inc.

17—SEALING COMPOUND for threads is chemically inert

T-Film, a Teflon-based compound, is said to form a continuous film, preventing spiral wicking and leakage, and contamination of material being conveyed. It is declared suitable for metallic and plastic threaded connections in all types of process pipe lines and apparatus. Because of Teflon's non-adhesive characteristics, this compound seals against

fluids and gases under pressure, manufacturer states; yet it permits joints to be easily broken when necessary, eliminating galling and sheared threads.

Two consistencies of T-Film are offered — light bodied for precision threads and viscous for manual application. Both are suggested for all chemicals to which Teflon is inert and for temperatures to 400 F. The compound comes in 2-oz jars and 8-oz cans and costs $1.00 per ounce. An economical preparation, 2 oz is intended to seal 30 to 40 joints in 1-in. pipe. Eco Engineering Co.

18—BOILER BASE with the under surface exposed to view

The Inspecto Base for waterleg type boilers is reported to overcome some problems which attend many bases for this type of boiler. With such bases, the entire under surface of the waterleg rests on masonry, hidden from view. Consequently, while subjected to external corrosion, it cannot be readily inspected. With the Inspecto Base, this under surface is exposed at all times. Being exposed, it can be inspected at any time, it is pointed out, and air can circulate about it to prevent external corrosion.

Constructed of steel, the Inspecto Base is shop fabricated and can be assembled by two men in less than an hour, says manufacturer, permitting boiler and base to be assembled the same day. Leveleg supports are a feature of this base, to permit leveling of the boiler. Form 62 describes this base. Plibrico Co.

19—ALUMINUM PAINT for plating high heat surfaces

You can aluminum plate high heat metal surfaces with the stroke of a brush, says the manufacturer of this new fast drying paint. It can withstand temperatures up to 1200 F, without discoloring or blistering, it is claimed, and a one-coat application provides a bright silvery finish that prevents rust, cracking or peeling. The paint contains a combination of fine aluminum and a new chemical binder. It defies heat because the finish fuses with the metal, as temperatures are increased, it is explained. Ready-mixed, it can be applied by brush or spray. Sapolin Paints Inc.

20—INDUCTION REGULATORS of more rugged construction

Single-phase induction voltage regulators are inevitably exposed to a continuous 120 cycle pulsating torque and to occasional high short-circuit stresses, and this new family of regulators is claimed better able to stand such rigors. Rotor and stator are designed mechanically to have the same natural torsional period to equalize the 120-cycle deflections — by proper choice of top support for the rotor, these deflections cancel each other. As a consequence, the motor and other auxiliaries mounted above the stator and rotor experience essentially no vibration, company explains, and the whole unit becomes more resistant to shock. These improved regulators cover a size range from 37½ through 125 kva. Westinghouse Electric Corp.

You may use the post cards provided on page 113 to ask for further information on any of these new products

21—ANNUNCIATOR is panel mounted, factory wired

The Model MLT is a panel-mounted individual lamp annunciator, furnished completely factory wired for the specified operation. It has a back-lighted illuminated nameplate fastened to the front of the small metal cabinet containing the lamps, relays and switches. The annunciator unit is installed in a 3¾-in. by 4½-in. opening in a panel. The rear of the cabinet holds the terminal block for

connection to the supervised "trouble" contact, power, and common audible service. Area of the nameplate available for engraved "message" with toggle switch is 2¼ in. by 1 in. Another unit (the Model MLP) is available, without toggle switch, with a 3 in. by 1 in. area for engraving. H. R. Kirkland Co.

22—STEEL FLOAT TRAP for draining corrosive liquids

Made entirely of stainless steel, this float trap has been developed for draining corrosive liquids from air, gas and steam confined in piping systems and equipment. This automatic trap is designed to drain liquids as fast as they are formed, continuously without permitting the escape of air or gas. The trap mechanism consists of a valve and seat, a lever, and a ball float inside of a case. The liquid, on entering the unit at the top, raises the float, opening the valve and permitting the escape of the liquid. An accumulation of any steam or gas lowers the liquid float, causing the float to drop. This action closes the valve. The trap is designed for 300 lb pressure and maximum total temperature of 800 F; it is made in sizes from ½ to 2 in. The V. D. Anderson Co.

23—WIRE STRIPPER eliminates triggers, cocking devices

A completely automatic wire stripper which is said to eliminate triggers, cocking or other holding devices, the "Hi-Speed" is designed to strip all kinds of building and fixture wire with a single squeeze of the handles. After the wire is stripped, a concealed cam holds the jaws open until the wire is removed, preventing them from snapping back and crushing the wire, particularly stranded and fine solid variety.

Formed steel handles afford an easy grip. Upper half of the steel cutting blade is rigid, while the lower half moves up and down in a precision milled slot. A blade adjustment screw increases the wire range of each stripper and compensates for variations in insulation thickness and adhesive properties. The tool is made in seven sizes for stripping Nos. 8 to 30 wires. Holub Industries, Inc.

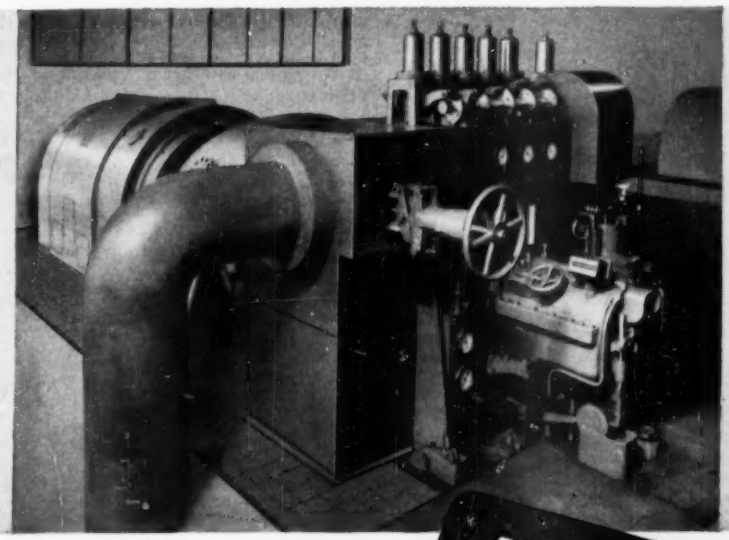
How a Southern Paper Company

Cuts Power Costs Three Ways

1
Eliminates Tube Failure

2
Reduces Maintenance

3
Cuts Blowdown Requirements



Main turbine room contains five turbine-generator units. You can get complete information on silica removal by writing for a copy of Bulletin 28R7135.

In a 33-month period, a southern paper company replaced 133 tubes and welded others. Now, after installation of Allis-Chalmers water conditioning, tube failures have been completely eliminated — along with virtual elimination of unscheduled maintenance. In addition, boilers have operated at top rating and efficiency for 12 months between scheduled cleanings. Blowdown requirements have become approximately half what they were before.

ALLIS-CHALMERS
WATER CONDITIONING
Equipment — Chemicals — Service

Remove Silica Content in Boiler Water

The job was done by reducing silica content 94% through use of a water conditioning system designed by Allis-Chalmers water conditioning experts. Before installation, silica content averaged 43.6 ppm. Now it averages 2.7 ppm. Equipment includes a 24,000-gph hot process softener, three 10-ft *Anthrafilt* filters, a surge tank, and chemical feeder. The system has been improved since original installation by the addition of a secondary hot phosphate unit.

How You Can Solve Your Water Problems

For any water problem, you'll find Allis-Chalmers chemicals, service, and equipment a useful addition to your power or process water application. Years of experience combined with a complete line of equipment enable Allis-Chalmers water conditioning experts to recommend sound, economical solutions to your problems. For help with your water conditioning, call the Allis-Chalmers district office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4200

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

For more data circle 527 on Post Card

CONSTRUCTION NEWS

Birmingham, Ala. — Alabama Power Co., Alabama Power Bldg., plans series of five hydroelectric generating plants on Coosa River, to supplement three existing such stations on that stream. Estimates of cost are being made. Application for permission has been made to Federal Power Commission, Washington, D. C.

Fairbanks, Alaska — City Council, City Hall, has plans under way for extensions and improvements in municipal steam-electric power plant, with installation of equipment for increased capacity. Cost reported about $1,500,000. R. W. Beck & Associates, Tower Bldg., Seattle, Wash., are consulting engineers.

Phoenix, Ariz. — Arizona Public Service Co., Phoenix, plans new steam-electric generating plant, with initial capacity of about 100,000-kw. Site will be determined soon and preliminary work placed under way. Proposed to have ready for service early in 1956. Cost reported about $14,000,000, with power substations, transmission lines and other operating facilities.

El Centro, Calif. — At recent special election, Imperial Irrigation District, El Centro, was authorized to arrange bond issue of $10,000,000, for proposed new hydroelectric generating station at Pilot Knob, on All American Canal, previously noted in these columns. It will have a rating of 33,000-kw. Bids are expected to be asked in near future. B. A. Weiss is executive engineer for District.

San Francisco, Calif. — Pacific Gas & Electric Co., 245 Market St., has secured permission from Federal Power Commission, Washington, D. C., for construction of new hydroelectric power plants on North Fork of Feather River, Butte County, Calif., to cost $40,500,000. Preliminary work is scheduled to begin in near future on initial station.

Wilmington, Del. — Delaware Power & Light Co., 600 Market St., has arranged a construction budget of about $23,000,000 during a 15-mo. period, including 1954, for extensions and improvements in power plants and system. Financing has been authorized.

Jacksonville, Fla. — Municipal Electric Department, foot of Laura St., has approved plans for new addition to municipal power plant, to cost about $1,200,000, exclusive of equipment, and work will proceed at once. As recently noted in these columns, entire project will cost over $2,500,000, with equipment for increased generating capacity.

Tampa, Fla. — Tampa Electric Co., Tampa, has plans under way for new generating station at Hooker's Point, forming third power unit at that location. Cost reported in excess of $1,500,000. Project is scheduled to be carried out in 1954.

Albany, Ga. — Maxwell Brothers, Inc., 2300 South Morgan St., Chicago, Ill., corrugated fiber and wirebound boxes and containers, is considering steam power house at proposed new branch plant at Albany, where site is being secured. It will comprise several large production buildings and is reported to cost in excess of $600,000.

Boise, Idaho — Idaho Power Co., Boise, is projecting plans for a series of three hydroelectric generating stations on Snake River in Hells Canyon area, each comprising large power dam, hydroelectric station, artificial lake, switching stations, transmission line connections, etc. Plants will be equipped with water turbines and generators for gross rating of about 780,000 kw. Entire program is estimated to cost approximately $130,000,000 over a period of several years. Application for permission has been made to Federal Power Commission, Washington, D. C.

Decatur, Ill. — Illinois Power Co., 154 East Main St., plans an expenditure of about $90,000,000, for extensions and improvements in power generating facilities, power substations, transmission lines and other operating facilities for a period of 48 mos., concluding in 1957. Company is disposing of a bond issue of $20,000,000.

Rockford, Ill. — Central Illinois Electric & Gas Co., 303 North Main St., will carry out an expansion program at local Sabrooke steam-electric generating station, with installation of new turbine-generator unit and auxiliary equipment. Work is scheduled for completion in 1955. Cost reported close to $6,750,000.

Centerville, Iowa — Iowa Southern Utilities Co. has arranged for a block of common stock to total about $2,000,000, portion of proceeds to be used for extensions in plants and system.

Des Moines, Iowa — Iowa Power & Light Co., 312 Sixth Ave., is arranging for a bond, preferred stock and note issue to total about $21,500,000, majority of proceeds to be used for expansion and improvements in power plants and system, including power substations, transmission lines, etc.

Morgan City, La. — Municipal Water & Electric Department has authorized expansion in municipal oil engine-operated generating plant, with installation of new generating unit and auxiliary equipment. Work will be placed under way soon.

Kalamazoo, Mich. — Sutherland Paper Co., Rutledge St., processed and other papers for food products, etc., plans steam power house at new paper converting plant in Portage Township, near Kalamazoo, comprising a number of buildings, totaling 450,000 sq. ft. floor space. Entire project estimated to cost about $2,750,000. Completion scheduled late in 1954.

Muskegon, Mich. — Consumers Power Co., Jackson, Mich., has authorized expansion in B. C. Cobb steam-electric generating plant at Muskegon, with erection of new multi-story addition and installation of high-pressure boilers and steam-electric generating unit of 135,000-kw. rating. Building will allow for installation of second unit of like rating in future. Cost reported in excess of $12,000,000. Completion of first unit is scheduled in 1956.

Independence, Mo. — City Council has been authorized by vote of citizens, to arrange bond issue of $1,500,000, for extensions and improvements in municipal steam-electric generating station, with installation of new 5000-kw. turbine-generator, boiler and auxiliary equipment, recently noted in these columns. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

Metuchen, N. J. — S. C. Johnson & Son, Inc., Racine, Wis., wax polishes, lubricants, etc., is considering construction of boiler house at proposed new factory in Raritan Township, near Metuchen, where tract of about 14 acres of land has been purchased. Proposed to begin work early in 1954. No estimate of cost announced — reported over $500,000.

New York, N. Y. — Consolidated Edison Co., 4 Irving Pl., is arranging a construction budget of about $80,000,000 in 1954, covering extensions in generating capacity, power substations, overhead and underground transmission lines and other operating facilities.

Solon, Ohio — Goff-Kirby Co., Fidelity Bldg., Cleveland, Ohio, cement products, builders' supplies, etc., plans boiler house at proposed new plant at Solon, for manufacture of ready-mix cement. It will consist of several buildings and is reported to cost over $1,000,000, with equipment.

Ardmore, Okla. — Signal Oil & Gas Co., 811 West Seventh St., Los Angeles, Calif., plans steam power plant at proposed new natural gasoline works near Ardmore. It will be equipped for processing about 40 million cu. ft. of natural gas daily and will represent an investment of several million dollars. It is understood that project will be carried out in 1954.

Bethune, S. C. — Kendall Co., Walpole, Mass., absorbent cotton, cheesecloth, print cloths, sheetings, etc., plans boiler plant at new textile finishing mill at Bethune, where large tract of land has been purchased. Work will begin soon. Project will consist of several buildings and is reported to cost in excess of $500,000.

Moncks Corner, S. C. — South Carolina Public Service Authority, Moncks Corner, has preliminary plans under way for new steam-electric generating plant on local site, with high-pressure boilers, turbine-generators and auxiliary equipment for large capacity. Cost reported close to $10,000,000.

Laredo, Tex. — Central Power & Light Co., Corpus Christi, Tex., plans expansion and improvements in gas engine-operated generating plant at Laredo, with installation of equipment to double present capacity. Cost reported close to $700,000.

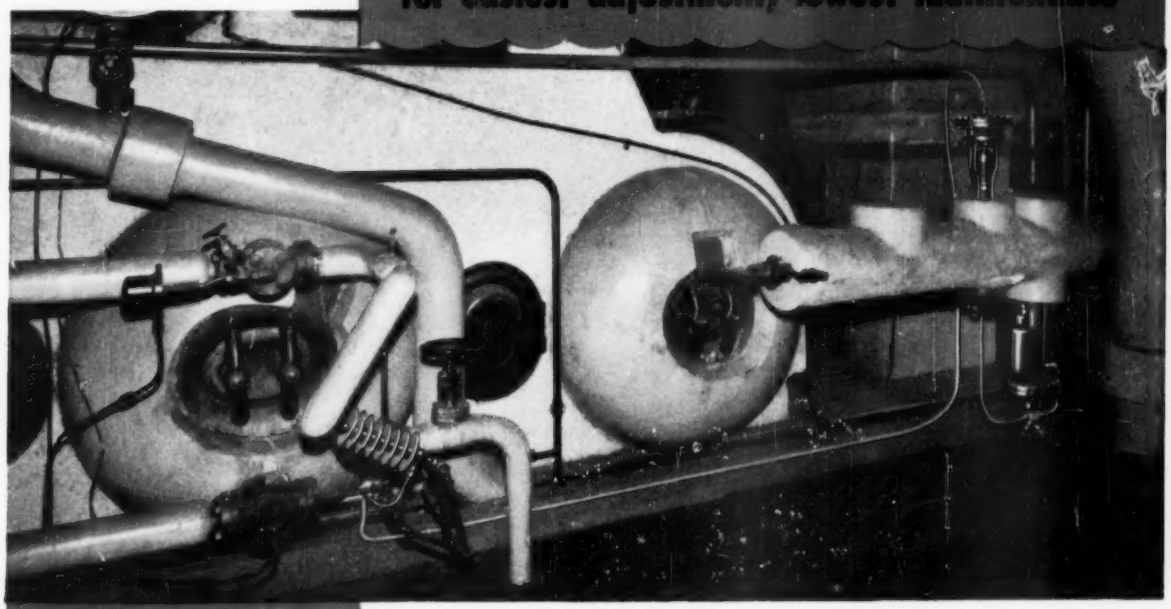
Fairmont, W. Va. — Monongahela Power Co. will expend about $24,400,000 during next 24 mos., concluding in 1955, for extensions and improvements in power plants and system, including power substations, transmission lines and other operating facilities.

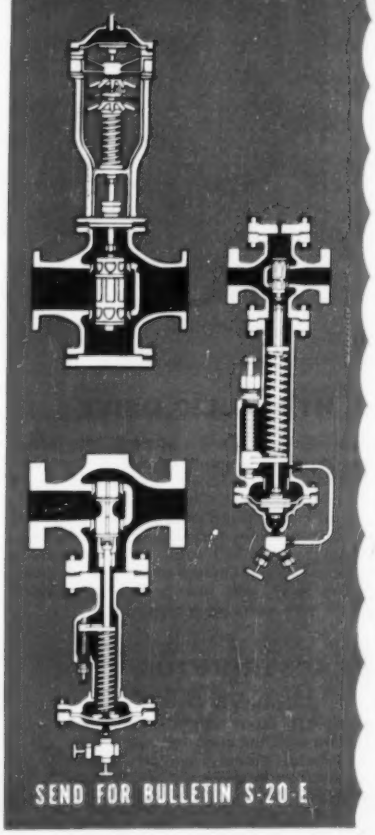
Janesville, Wis. — Wisconsin Power & Light Co., 122 West Washington St., Madison, Wis., has authorized expansion in steam-electric generating station near Janesville, including new addition to provide for installation of high-pressure boilers, 60,000-kw. generating unit and auxiliary equipment. Cost estimated about $11,000,000. Sargent & Lundy, 140 South Dearborn St., Chicago, Ill., are consulting engineers.

Wisconsin Rapids, Wis. — Consoweld, Inc., care of Consolidated Water Power & Paper Co., Wisconsin Rapids, recently organized as a subsidiary interest, plans boiler house at proposed new local plant for manufacture of plastic products for surfacing service. It will comprise several buildings, with main structure 250 x 400 ft. Cost estimated about $1,500,000.

Swartwout SC Type FW1 Feed Water Regulators

for easiest adjustment, lowest maintenance





SEND FOR BULLETIN S-20-E

1 **SWARTWOUT SC TYPE FW1** feed water control system consists of thermo-hydraulic generator and regulating valve. Generator piping is a self contained support; no brackets are required. Moving parts are reduced to a minimum. Since there are no floats, levers, turnbuckles or pulleys to line up, regulator valve may be located anywhere. Another plus feature is that speed and degree of generator response can be quickly, easily changed without special tools, cutting or welding.

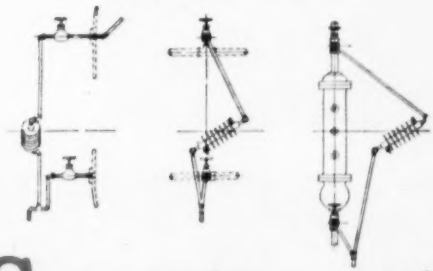
2 **FW1 REGULATING VALVE** is of balanced, tight seating type ruggedly constructed. Long life V-type stem packings. Diaphragm is molded of special rubber with four plys of cord fabric, moves from closed to open position without any stretch imposed on it.

3 **SL DIFFERENTIAL PRESSURE VALVE** can be used with Swartwout FW1 Feed Water Regulators to smooth out erratic feed water pressures. Stainless steel disc, seat, and stem and special formula molded rubber diaphragm.

4 **TYPE A DIFFERENTIAL PUMP GOVERNOR** can be used with FW1 regulating systems to maintain required pump discharge pressure. No stuffing box on moving parts; easy screw type adjustment.

A-8481

TYPICAL GENERATOR INSTALLATIONS



Swartwout

POWER PLANT EQUIPMENT
PROCESS INDUSTRY CONTROLS
INDUSTRIAL VENTILATION

THE SWARTWOUT COMPANY • 18511 EUCLID AVENUE • CLEVELAND 12, OHIO

For more data circle 528 on Post Card

Riley Traveling Grate Spreader Stoker Fires 200,000 lbs./hr. Riley Unit at B. F. Goodrich Company Akron, Ohio

GRATE SURFACE

This view of the grate shows the overlapping of special growth resistant alloy clips mounted on structural steel T bars. Note how clips separate to free themselves of ashes and clinkers. Use of small grate clips two inches wide with a six-inch pitch minimizes warping or cracking. Tuyeres in center and at sides of clips provide uniform air distribution.

HYDRAULIC DRIVE

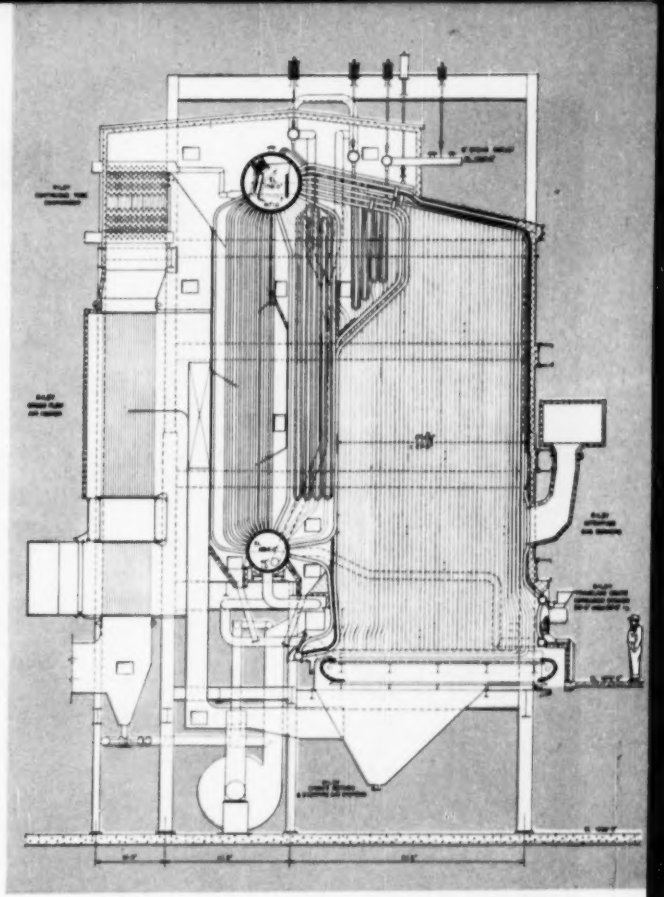
The Riley Grate Drive is a hydraulically driven ratchet drive, completely enclosed and self-lubricated. No sprockets, chains and speed reducers are needed. Hydraulic circuit provides positive overload protection to the grate; Riley Drive provides complete grate speed control from zero to full load. Pressure gauge informs operator of amount of load at all times. Drive operates with low power consumption and with practically no maintenance.

FEEDER DISTRIBUTOR

The Riley Feeder is designed to provide uniform positive feed regardless of coal characteristics and moisture. Avalanching with fine coal does not occur. The Overthrow Distributor provides uniform longitudinal and lateral distribution and prevents damage or outage caused by wedging of foreign materials between distributor and housing.

Here's Proof of **RILEY LEADERSHIP** in the Spreader Stoker field . . .

. . . many leading public utilities and industrials are installing Riley Traveling Grate Spreader Stoker fired boiler units with steam capacities up to 250,000 lbs./hr.!



When large traveling grate spreader stoker-fired steam-generating units are being considered, many leading public utilities and industrials select Riley equipment. They recognize Riley for its extensive experience in the fuel-burning and steam-generating field. They, as most power engineers, prefer the Riley Traveling Grate Spreader Stoker for the superiority of its Riley-developed Hydraulic Drive and Riley Grate surface, the uniformity of its feed and distribution from the Riley overthrowing distributors, its high day-after-day overall efficiency, continuity of operation and low maintenance.

B. F. Goodrich, Champion Paper & Fibre, Kennecott Copper, Gaylord Container, Montana-Dakota Utilities, Utah-Idaho Sugar have all installed large Riley traveling grate stoker-fired steam-generating units. If you are considering high-capacity spreader stoker-fired units, be sure to call in a Riley engineer. It will pay you to do so.

Montana-Dakota Utilities • Mandan, North Dakota
250,000 lbs./hr. Riley Steam Generator
26′ x 20′ Riley Traveling Grate Spreader Stoker

Other Riley Traveling Grate Stoker Installations

Gaylord Container Corp.
Bogalusa, La.
250,000 lbs./hr. Riley Unit
22′ x 20′ Riley Traveling Grate Spreader Stoker

Kennecott Copper Company
McGill, Nev.
235,000 lbs./hr. Riley Unit
28′ x 18′ Riley Traveling Grate Spreader Stoker

Utah-Idaho Sugar Company
Moses Lake, Wash.
250,000 lbs./hr. Riley Unit
28′ x 19′ Riley Traveling Grate Spreader Stoker

Champion Paper & Fibre Company
Canton, N. C.
200,000 lbs./hr. Riley Unit
24′ x 22′ Riley Traveling Grate Spreader Stoker

United States Steel Corp.
General Motors Corp.
General Electric Co.
Celanese Corp. of Amer.
General Time Instr. Co.
Iowa Public Service Co.
City of Hastings, Neb.
City of Springfield, Minn.
John Deere & Co.
Penn. Electric Co.
U. S. Gypsum Co.
Swift & Co.
Ohio Edison Co.
Stokely Foods
City of Ames, Iowa
City of Provo, Utah
Monsanto Chemical Co.
Central Ill. Light Co.
Bendix Aviation Co.
Garlock Packing Co.
Armstrong Cork Co.
Pennsylvania R. R.
City of Napoleon, Ohio
City of Troy, Ohio
Iowa-Illinois Gas & Electric Co.
Corn Belt Power Coop., Iowa
E. I. duPont de Nemours Co.
Minnkota Power Coop., N. D.

TRADE MARK Rx REGISTERED

RILEY STOKER CORPORATION

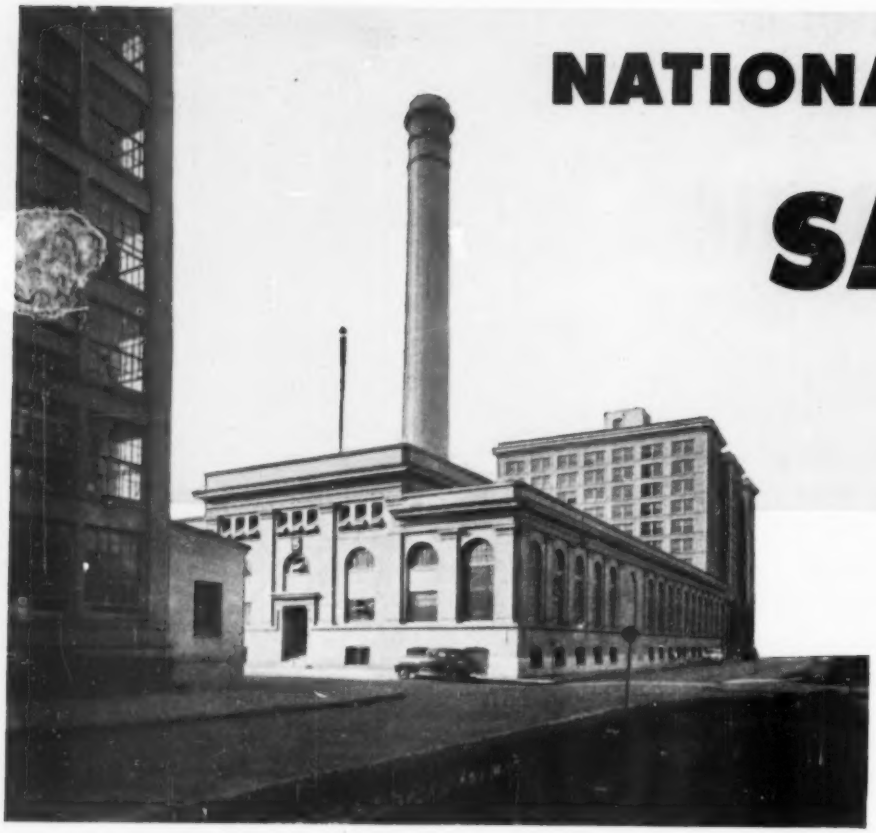
WORCESTER, MASS.

Boston, New York, Philadelphia, Buffalo, Washington, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Tulsa, Houston, Denver, Salt Lake City, Los Angeles, Portland, Seattle

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS
WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

NATIONAL CASH SAVES WITH



No smoke nuisance! Located near a beautiful residential area, National Cash Register's steam plant meets strict control regulations by using dust collectors and smoke recorders.

If you operate a steam plant, you can't afford to ignore these facts!

BITUMINOUS COAL in most places is today's lowest-cost fuel, and coal reserves in America are adequate for *hundreds* of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

National Cash Register recently installed two modern, stoker-fired boilers in their giant Dayton, Ohio, plant. These boilers supply the major part of the steam NCR uses in generating power for 28 factory buildings and heat for nearly 72 acres of floor space. The savings made have convinced NCR that for high efficiency and low costs, you can't beat an up-to-date bituminous coal-fired installation.

Big loads! Loads in this large plant run up to 300,000 lbs. per hour. The coal consumption runs about 60,000 tons a year.

Additional case histories, showing how other types of plants have modernized and saved money with coal, are available upon request.

FOR HIGH EFFICIENCY
FOR LOW COST

REGISTER

$70,000 A YEAR

MODERN COAL EQUIPMENT

One of NCR's two new boilers. Older pulverized coal boilers handle the swings. National's former coal-handling system—with only a few minor changes—automatically and efficiently handles the two kinds of coal required.

Before you build a new plant or remodel your present one, let a consulting engineer show you how a modern bituminous coal installation—tailored to your needs—can save you money.

With modern coal-burning equipment, you can save from 10% to 40% on steam costs. Automatic coal- and ash-handling systems can cut your labor costs to a minimum.

You're set for the future, too, with coal. Coal reserves are virtually inexhaustible. America's highly mechanical coal industry is the world's most efficient. Thus you are assured of a dependable supply of coal, at relatively stable prices, for years to come.

BITUMINOUS COAL INSTITUTE

A Department of National Coal Association
Southern Building, Washington 5, D. C.

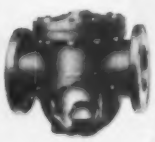
YOU CAN COUNT ON COAL!

For more data circle 530 on Post Card

6 OF THE MANY McALEAR CONTROL GUARDSMEN

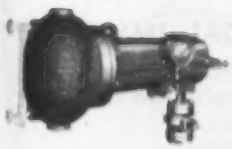
Pilot-operated pressure reducing valve for accurate control of reduced pressures . . . single seated closed valve affording dead end service.

Stop and check control — used with two or more boilers — automatic safeguard against reverse steam flow.

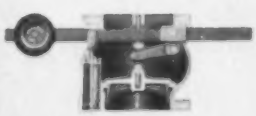


Suction and pressure type strainer —clamped or bolted cover—adaptable to any strainer service.

Self-cleaning "Y" strainer — used to protect regulators, pumps and traps by removing foreign matter from the line.



Feed water regulator—used for continuous feed to boiler to maintain water level. Has mercury cut-out switch as additional safeguard in case of low water.



Back pressure valve—Single seated vertical type . . . efficient—noiseless. Operates with condensing and non-condensing engines.

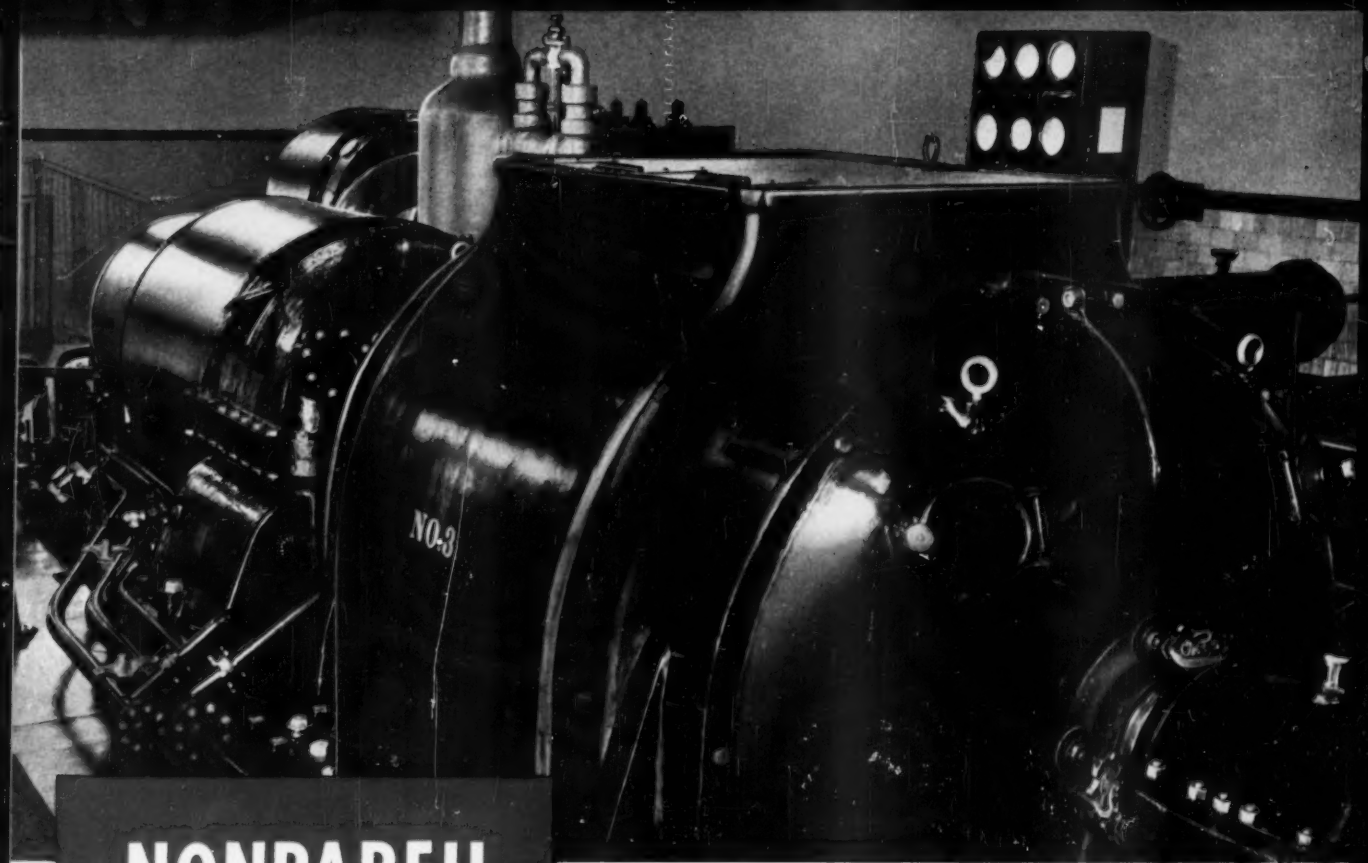
You can forget control problems if you REMEMBER McALEAR

There's a safe way to forget all about your control problems—just remember McALEAR. For when you use McALEAR controls you benefit from a background of fifty years of experience covering every type of installation. You know you have controls engineered to an exactness . . . controls that are just right for the specific job. You can depend on McALEAR because (1) There is an expert engineering service behind every product; (2) McALEAR sales representatives are hand picked for control know-how; (3) McALEAR controls are available through leading plumbing and heating wholesalers.

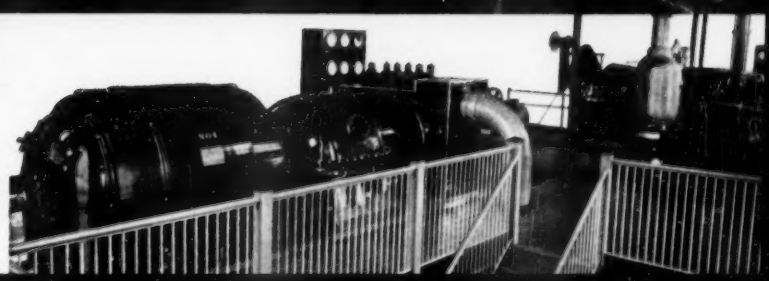
McALEAR
PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE
controls
for STEAM, WATER, AIR, OIL or GAS

McAlear Manufacturing Company
1901-1919 South Western Avenue
Chicago 8, Ill., U.S.A.

For more data circle 531 on Post Card



NONPAREIL
TRADE MARK
Turbine Oil



How they eliminated turbine oil replacements

● Operators of this midwest power plant recall the time when a conventional lubricant was used in the plant's three turbines (now, four). A fill of oil was good for about three years and then it had to be replaced because of increased acidity and other indications of oil deterioration.

In 1939, a Standard Oil lubrication specialist recommended NONPAREIL Turbine Oil, and the switch was made. Since that time, none of the original fills of NONPAREIL has needed to be replaced. For that matter, no fill of oil has needed to be removed from its turbine for any purpose. Lubrication systems have remained clean. Neutralization numbers of oil fills have stayed below 0.06 mg. KOH/gm.

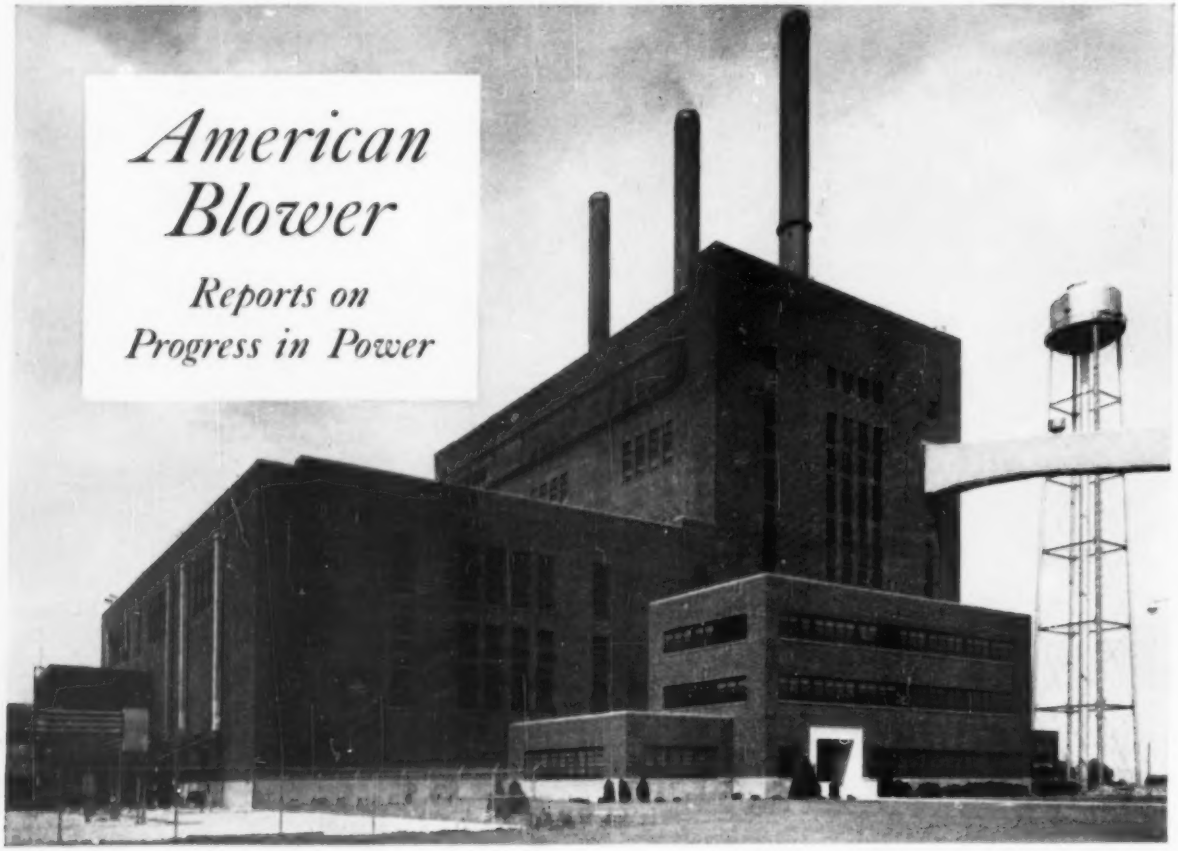
Fourteen years of trouble-free turbine lubrication is just the beginning for this plant. Each fill of NONPAREIL is guaranteed in writing to last as long as the turbine it lubricates and to maintain a neutralization number below 0.15 mg. KOH/gm.

Ask the Standard Oil lubrication specialist serving your area of the Midwest to show you how NONPAREIL and its written guarantee will assure you of completely trouble-free lubrication for the life of your turbines. Phone your local Standard Oil office. Or, write: Standard Oil Company, 910 So. Michigan Ave., Chicago 80, Ill.

STANDARD OIL COMPANY STANDARD *(Indiana)*

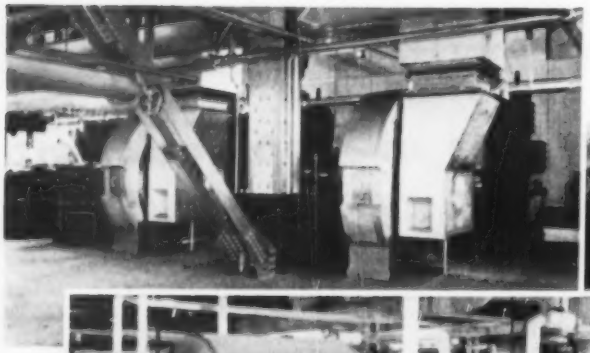
American Blower

Reports on Progress in Power

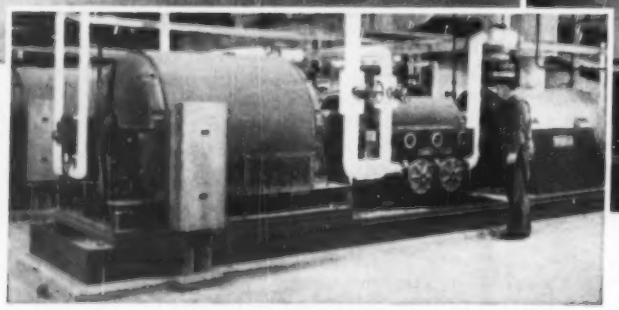


New Justin R. Whiting Station, Erie, Michigan. Architect: Carl C. F. Kressbach. Engineers: Commonwealth Associates, Inc.

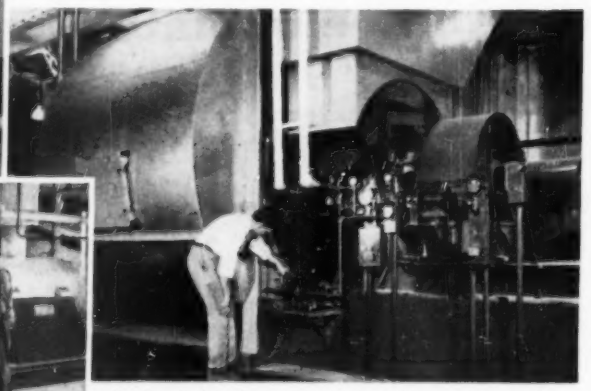
Consumers Power prepares for



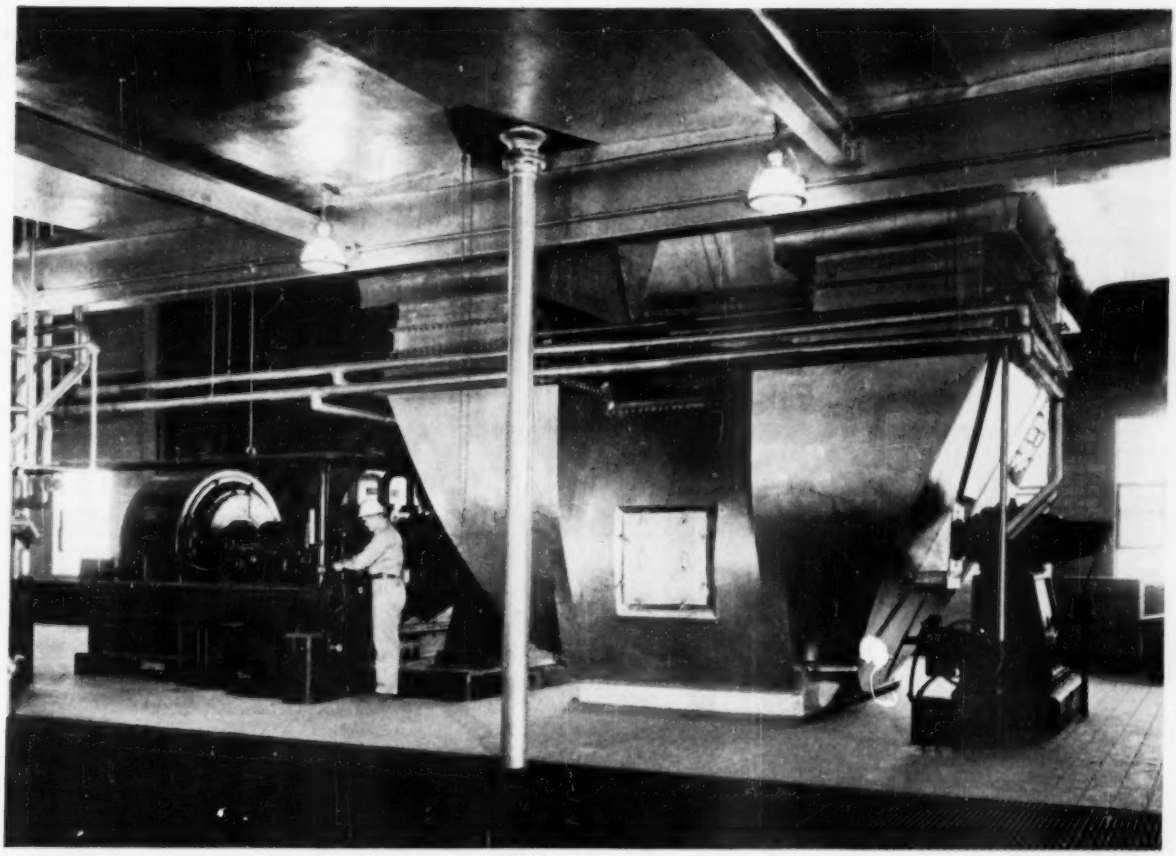
←
Shown are 2 of 12 American Blower Primary Air Fans, each with a rated capacity of 18,700 cfm at 29" wg air at 495° F.



Boiler feed pumps shown equipped with American Blower Gyrol Fluid Drive control, have a rated capacity of 1600 gpm of 300° F. water at 1775 psig discharge and 75 psig suction.

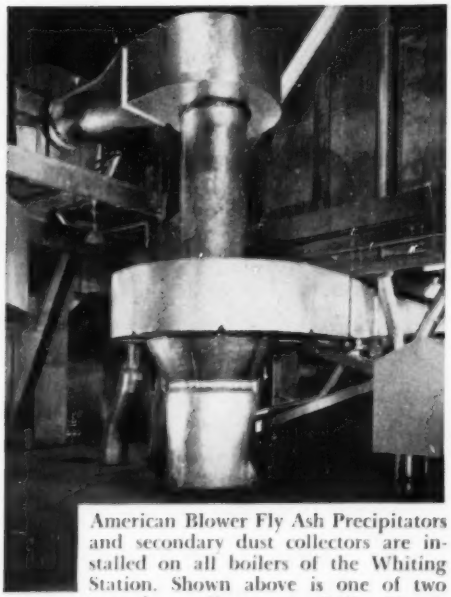


Each of the three American Blower Forced Draft Fans is equipped with a Gyrol Fluid Drive for smooth stepless fan control.



American Blower Induced Draft Fan with Gyrol Fluid Drive. Rated capacity is 350,000 cfm of 275° F. air at 15" SP.

future with new Whiting Station



American Blower Fly Ash Precipitators and secondary dust collectors are installed on all boilers of the Whiting Station. Shown above is one of two secondary collectors on Boiler No. 2.

Michigan's Consumers Power Company has a reputation for pioneering.

Among the first to transmit over 100,000 volts over high tension wires, they also have an impressive record in the development of rural electrification.

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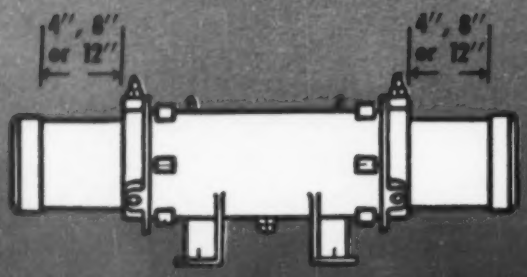

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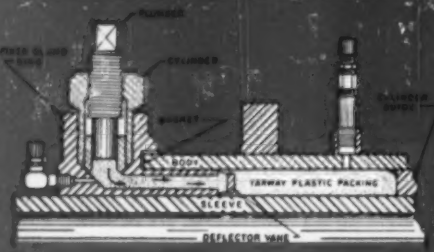

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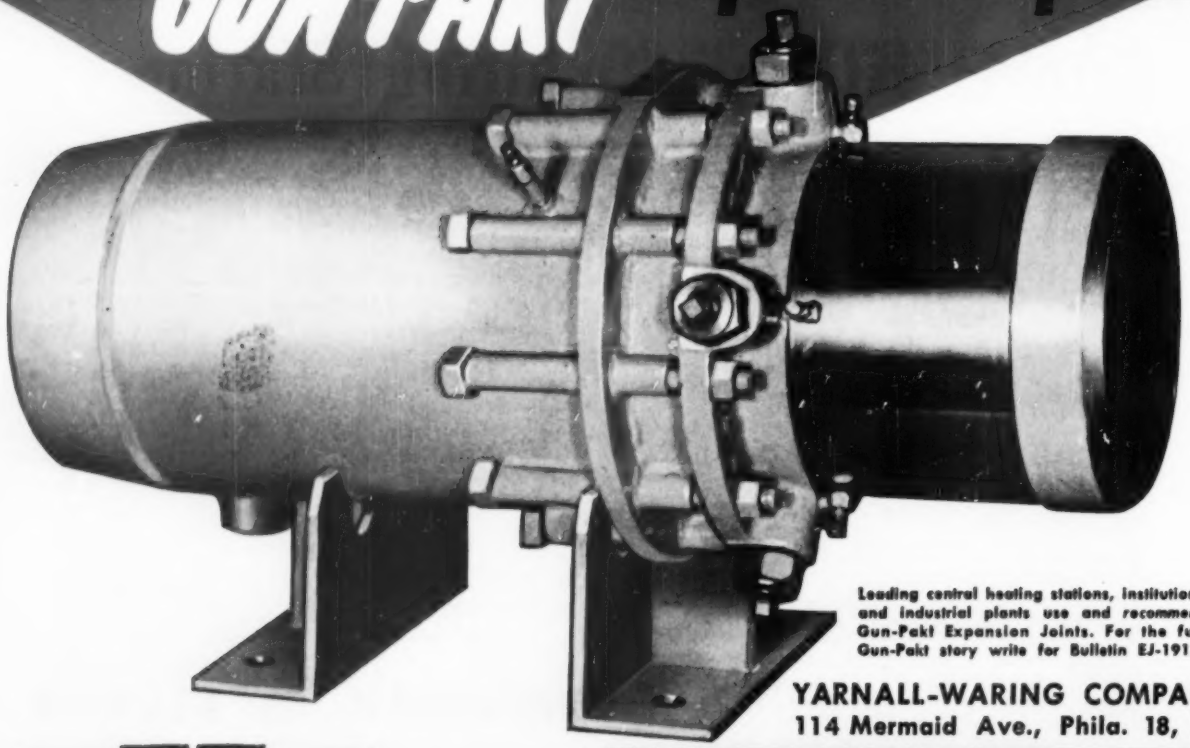

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The ATOMIC POWER AGE Begins

ON THE TWO PAGES that follow we present an article describing briefly the nature of the Atomic Energy Commission's recent decision to proceed with the design and construction of a full-scale nuclear power plant for industrial service. This was a momentous decision, one of great import to the human race because it promises to multiply by thirty times or more the available energy resources of the earth. At least it ensures future generations of an adequate supply of energy until that distant day when man discovers how to use the energy of the sun, direct. Of perhaps even greater significance to us at the present time is the fact that now, for the first time, we will be engaged in a large-scale atomic project which does not have destruction as its object. It holds rich promise for a better world.

The problems involved in this new atomic project are complex and involved but there is nothing in it that is impossible, indeed, there is no question in anyone's mind associated with the plan than that we will have a nuclear power plant in operation in around four or five years, perhaps even sooner. This is quite different from estimates of several years back which put practicable atomic power plants from 25 to 50 or more years away. The pace of modern scientific development has a strange way of upsetting predictions when such predictions are not colored with sufficient imagination.

For about eight years, in these pages, we have professed our faith and confidence in the future of nuclear power, not because we had a better insight into the problems it presents or because we were possessed of some unique kind of crystal ball but merely because we could never forget that the future has always outstripped man's imagination, ever since he first warmed his hands over a lump of glowing coal.

Andrew C. Kramer

Industrial Power From Nuclear

First atomic power plant to be built by the Government but this month legislation will be introduced in Congress to the end that private development of atomic power may go forward. First plant will produce at least 60,000 kw and probably more. It will be built at one of the AEC installations

By ANDREW W. KRAMER

THE RECENT DECISION of the Atomic Energy Commission to proceed with the construction of a full-scale nuclear power plant marks what is without doubt the most important advance in the Age of Power since Watt built his first steam engine. It ushers in the Atomic Power Age.

Significant as the AEC announcement was in its implications, it was long overdue, coming almost 11 yr after the first nuclear reactor went into operation at the University of Chicago in December 1942. It is understandable, of course, why no work on atomic power development took place during and immediately following the war years but it is less obvious why there has been so much reluctance towards making a start during the last five years when the subject has received such wide discussion. This reluctance is probably only a manifestation of the resistance which man has always displayed toward the adoption of new ideas.

There has been no particular mystery concerning the basic principles of an atomic power plant. The primary form of energy in a nuclear reactor is the kinetic energy of the fragments resulting from the fission of uranium. This kinetic energy is degraded into ordinary heat by successive collision of the fragments with atoms of the reactor core. The problem is that of extracting this heat and using it in conventional steam or gas turbines.

There are literally dozens, perhaps hundreds of ways of doing this. Indeed, as Walter Zinn, Director of Argonne National Laboratory says, "I could give you so many drawings of reactors you would have to haul them away in a truck." With the basic principles so well established one may wonder why progress towards the construction of an actual power plant is not further along, why engineers and private interests have not been more vigorous in their efforts to remove whatever technical, political and financial obstacles may have stood in the way.

True, among a certain few, vigorous effort has not been lacking. From the beginning, companies like Monsanto Chemical and Dow Chemical have been extremely active in stimulating and encouraging interest in this new great field, and during the last two or three years a number of utility company groups have organized study groups whose efforts resulted in the development of a number of possible atomic power plant designs.

Prestige In Danger

All of this work, however, remains on paper; it has not resulted in the construction of any plants. There are, of course, restrictions in the Atomic Energy Act which make it impossible for private companies to proceed with the construction of nuclear power plants but the utilities seem to have been unwilling or unable to make definite offers to finance such projects if the legal restrictions were removed.

"Before making this decision," said Commissioner Murray when he made the announcement in Chicago, "we had to answer a fundamental question — would private industry, if permitted to do so by law, enter aggressively into the full-scale power reactor construction and testing stage? *The answer that we derived after several years of probing this problem, with the help of competent industrialists, was negative.* Many companies wanted to get into the game, but they all demanded in one way or another that the Government pay the bill."

In the absence of other considerations it is unlikely that the Atomic Energy Commission would have made this move to build a plant even now but our international prestige is in danger, and the AEC plowed through some tough policy problems in arriving at this decision to build a plant. Issues that have stalled atomic power progress for two or three years were either met head on or pushed aside.

In the face of Russian development of H-Bomb techniques, the AEC could have used this threat as an excuse for stalling on the power issue, implying that all its energies were needed to meet military objectives. Instead it chose to play up the industrial power program as a diplomatic coup. In doing this the Commission is taking no chances. Our weapons program is ample to keep the US far ahead in the atomic armament race. We evidently have all the fissionable material needed for nuclear weapons.

So far, perhaps 95 per cent of all the money spent for atomic energy, and we have spent more than 6 billion dollars, has been spent on the weapons program. Russia has not hesitated to use this fact in its propaganda, labeling us as war mongers, not interested in the peacetime uses of atomic energy.

Recently, the situation took a new and ominous turn. "It is no secret," said Mr. Murray in his Chicago speech, "that our atomic weapons program depends upon the receipt of substantial quantities of uranium from foreign nations. These friendly nations are banking on the United States to help them build their nuclear power plants of the future. Unless we embark on an all-out attack on our nuclear power program immediately, we may be deprived of foreign uranium ores."

Nuclear Power Race

What Murray did not say at Chicago was that Belgium and South Africa, both large producers of uranium ore and both deficient in other forms of potential energy, had put strong pressures on the US. In return for their uranium, they demanded that the US tell them how to build nuclear power plants. Behind these demands was a really shocking possibility. Eventually, Soviet Russia may solve the problem of atomic power. We must, therefore, become fully conscious of the possibility that power-hungry countries will gravitate toward the USSR if it wins the nuclear power race.

Another sensitive factor in the AEC's decision was in keeping the first straight power reactor completely

Fuel in Four to Five Years

Operating personnel of Oak Ridge National Laboratory's new homogeneous reactor checking control and operating features of this new reactor which recently produced 150 kw of electricity from atomic energy. This is an experimental installation

under government control. Some members of the Commission feel that the government's atom monopoly is already holding back technical progress and want private industry to move into the atomic power field. However, since no definite privately financed offers to build a power reactor were submitted, the Commission was free to go ahead on its own. Even in this plan to build the first power reactor the AEC does not exclude private participation. Private industry is invited to invest risk capital in the building of the steam and turbine portions of the plant.

The projected plant will completely skip the pilot plant stage. It will be a full-scale atomic power plant for industrial use. This is a sensible plant because enough is known about reactor technology to assure the technical success of the project. The area of uncertainty lies in the economic aspects of the development.

The contract for the design and construction of this first atomic power plant was given to Westinghouse primarily because of that company's previous experience with the particular type of reactor chosen. This is a pressurized water reactor in which water under high pressure removes the heat from the reactor core and transfers it to heat exchangers which also function as steam generators. The steam will drive conventional turbines. Details remain to be worked out but the fuel for the reactor will probably be enriched uranium, that is, uranium with a higher than normal percentage of fissionable U-235.

The important element in this development is not what kind of a reactor it will use or who will build, or own, the plant, but *that it is to be built at all.* Enough data are available to know that power could be produced by any of a number of different kinds of reactors, and that the power costs between the various types would not vary much. As disclosed by the studies of the utility groups and reported in the Power Reactor Feasibility Report issued last June, the power costs with various reactors were estimated to range between 3.6 and 12.5 mills per kilowatt hour. The power cost of the proposed AEC plant will, probably, be somewhat higher than those of conventional plants taking into account the fixed charges but competitive power costs will be of less importance in the operation of the plant than its technical feasibility.

It is reasonable to assume that the construction cost of this first atomic power plant, which will develop at least 60,000 kw and probably more and which will cost in the neighborhood of 40 million dollars, will be much greater than even a second plant. What is needed above anything else is experience, and the construction and operation of this first plant will provide that. The electric utility companies, therefore, need not regard this initial venture into the field of atomic power with apprehension. It is an experiment and does not mean that the Government is going to compete with the power companies in this new field. The plant will help to furnish electric power to one of the AEC's vast gaseous diffusion plants, probably the one now under construction at Portsmouth, Ohio. As such it will, to a very minor extent, be competitive with the utility systems also supplying power to this project, but the proposed 60,000 kw is so small a proportion of the total power needed as to make the competitive element of little or no significance.

From a social standpoint, the importance of this project cannot be overestimated. It is of greatest significance because it marks Man's entrance into the Atomic Power Age. It does not mean that all of our fuel-fired power plants are to be discarded or that they are all going to be converted to the use of atomic energy in the next decade or even in the next half century but there can be little question as to its ultimate significance. It will profoundly influence our lives in the decades to come. After all, the whole electric power industry we now have is no older than one man's lifetime

Out on the desert near Idaho Falls, Idaho, for more than two years, Argonne National Laboratory has had in operation a small experimental power plant in conjunction with the breeder reactor. Few who have had the privilege of standing beside this reactor, which externally is a monolith of concrete some 30 ft square and about as high, can have failed to grasp the astonishing significance of that installation. Here, is a seemingly inert mass of concrete, noiseless, motionless, vibrationless — no smoke, no dust or fly-ash, no coal, no fumes, yet in the next room is a turbine generator turning out electric power. True, the generator is a small one, but large enough to supply all the electrical needs of the building. Even more amazing is the fact that while this electric power is being generated, the reactor is actually producing more nuclear fuel than it is consuming.

Magic? Magic indeed. No matter what the difficulties are; no matter how many the obstacles, technical, economic, political, an achievement such as this simply cannot be ignored or discounted. Atomic power is a reality. The problems are still many and difficult but the way is clear. The pattern for the nuclear power plant is set; it will be a thermal plant using a nuclear reactor as a source of heat with either steam or gas turbines as a prime mover. It is as simple as that, but as we said in these pages in December 1948 — five years ago — it is high time we get started.

Business Uncertain? Electrical Industry Up

Because of stabilizing factors inherent in the electrical industry the recession in general business predicted by economists is not likely to affect continued growth of the utilities

THE YEAR 1953 can be marked down in industrial history as an all-banner year so far as the growth and continued development of the electrical industry is concerned. Not only did it attain a total output of some 443 *billion* kilowatthours and an installed generator capacity of well over 87 million kilowatts but the year also produced new records in the sizes of generators, transformers, switchgear and other equipment. Today oil circuit breakers are being built for operation on 330 kv with interrupting capacities of 25 million kva! Indeed, the designers of these breakers foresee no difficulty in handling ratings up to 40 million kva on short circuits of 400- to 500-kv systems when that becomes necessary. Outstanding technical advances in generator design makes it possible to obtain blocks of power from single generators of 250,000 kva capacity or even higher. This is typical of what is happening throughout the whole of the electrical field — limitations concerning voltage, capacity, speed of operation, etc., which seemed to block progress a few years ago are removed as the need arises.

Expansion of the industry continues at approximately the same rate as during the past three or four decades. A year ago, in the January 1953 issue of this publication we directed attention to the significant relationship between population growth and the increase in the use of electric power. Now, a year later, we have further evidence of the truth of this relationship, not only the parallel increase in both population and electric consumption but, more significantly, in the fact that this growth continues in the face of a downward trend in general business activity. This, in fact, was the premise we made last year — that the growth in the use of electricity is virtually unaffected by variations in general business activity. Studies of future business conditions made by the Federal Reserve Bank and other statistical organizations indicate the accuracy of this premise. They show that, while the trend in business activity during the next few years is expected to be downward, the growth in the use of electricity will continue upwards.

There are a number of good reasons for expecting a mild decline in business activity aside from the old idea held by many that business follows a cyclical pattern and that it is now time for a downswing. More scientific predictions are based on statistical analysis of such factors as disposable consumer income, installment credit, business inventories, farm income, home building activity, new family formations, curtailment of government contracts, etc. Details of such analyses cannot be presented here but the results obtained by several organizations making such studies indicate a general decline in business activity. With respect to our total national product, predictions indicate a drop of some 19 billion dollars by 1955. At the same time there will be a reduction of consumer disposable income of 9 billion dollars.

The electrical industry, naturally, will also be adversely affected by these factors but there are compensating influences which more than make up for the adverse elements. For example, even though there will be fewer new family formations in the next few years, it is expected that there will be a substantial increase in the use of electricity by residential and small light and power customers. This will result from the greater use of appliances — deep-freeze units, room coolers, television receivers and new automatic household equipment of all kinds. There will be greater emphasis on the use of lighting, and quite likely the current interest in space heating by electricity will result in the addition of much greater domestic loads. The number of kilowatthours per customer has risen

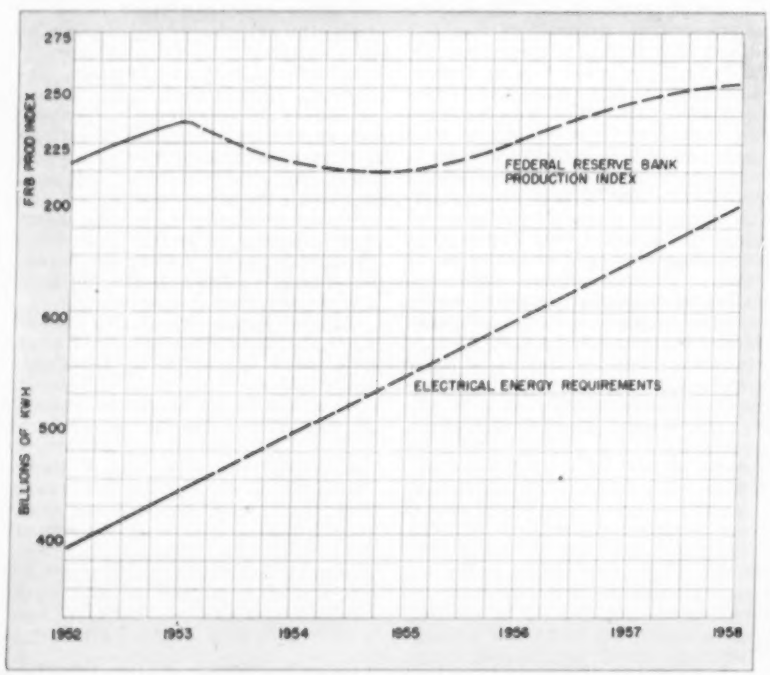


Fig. 1. This chart based upon the Federal Reserve Bank Production Index shows how general business conditions and our electrical energy requirements will be related during the next five years. The electrical load will continue to move upwards

Fig. 2. New manufacturing techniques help to cut costs. Here is illustrated a new method of using electromagnetic models to determine transient voltages in transformers developed by General Electric Co. The model shown is ⅛ the size, 1/216 the weight of the large 33,333-kva unit and was available in ⅒ the time of the actual core and coils

from 1500 per year in 1948 to a present national average of 2300 kilowatthours. By 1963, it is estimated, this figure will rise to something over 4300 kilowatthours, if the foregoing trends continue.

Generating Capacity

Previous annual surveys have indicated that the electric generating capacity of the U. S. has been doubling every ten years for the last three or four decades, and that since 1921 the consumption of electric energy has increased at the rate of 7 per cent annually — just twice the rate of rise in our national product. Forecasts for the next ten years, taking into account every possible factor, indicate that this same rate of growth will continue. This in face of a general business decline in the immediate future and the prospect of fewer new family formations during the next few years.

While the population is steadily increasing, the increase is largely in the young and the old age groups. There has been a much smaller increase in the 20 to 34 year age group since 1940, but between 1950 and 1960, there will be an actual decrease in this group. The decline in this age group is the result of the low birth rate during the depression years. The drop in this age group will result in the formation of fewer families in the immediate future, indeed, it is expected that the number of new family formations will drop from 750,000 last year to a rate of 600,000 in 1956 and 1957. This will affect the use of electrical power adversely but other compensating influences, as already pointed out, will more than make up for it. The high standard of American living depends upon the use of electricity in increasing amounts and the demand for power is rising in all segments of our economy. At the present time also, the Atomic Energy program requires astronomical quantities of electric power, all of which helps to create a need for more and more power producing facilities.

Technically also, the electrical industry is in a favorable position. Continued improvement in the designs of systems and equipment, in the standardization of apparatus and methods and in the development of new manufacturing techniques, has made it possible for the utilities to effect reductions in both the cost of station construction and the cost of producing electricity. The largest stations on the average are able to produce a net kilowatthour for three to four mills, including investment charges.

The average cost per kilowatthour for the privately-owned Class A and B utilities according to the latest figures of the Federal Power Commission is 4.84 mills. This is somewhat lower than it was during the years since 1947 but higher than during the period from 1942 to 1946. Figure 3 shows the variation in production costs during the period between 1942 and 1952. It rose to a peak of 4.99 mills in 1948 and then started downward again. This downward trend in production cost is the result of several factors one of which has to do with the more general use of capability figures for machine ratings. This decreases the cost per kilowatt of capacity and to some extent the production cost per kilowatthour. Another factor is the use of the fixed charge percentage by the reporting utilities in place of the uniform 15 per cent used in previous studies.

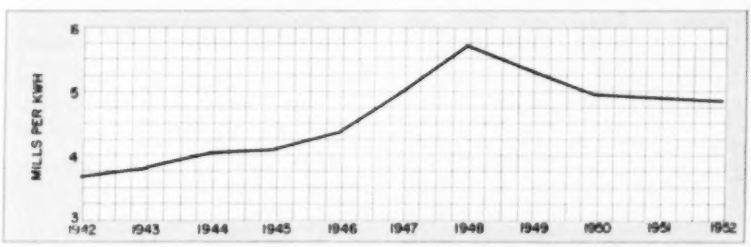


Fig. 3. Variation in production costs of electricity during the period from 1942 and 1952 as reported by the Federal Power Commission. Production costs have been falling since the 1948 peak

The average cost per kilowatt of capacity of steam stations at present is somewhat lower than it was in 1950. Today, this averages between $130 and $135 as compared with a range of from $145 to $150 in 1950. Of course, individual station costs vary widely depending upon the type of fuel used, the size of the plants, architectural features, etc. The use of larger generating units at a lower cost per unit of capability, for example, will effect a reduction in overall station costs.

The cost of fuel continues to be the major factor in the production cost of power; it accounts for 80 per cent. That is why the most thermally efficient plants have the lowest production cost. For plants of over 100,000 kw capability the cost runs as low as 2½ mills per kilowatthour. Plant labor and superintendence costs at the present time run close to 10 per cent of the total production cost.

Power Engineers Take Long Step to 4500-psi, 1150-F Steam

By CHESTER R. EARLE *

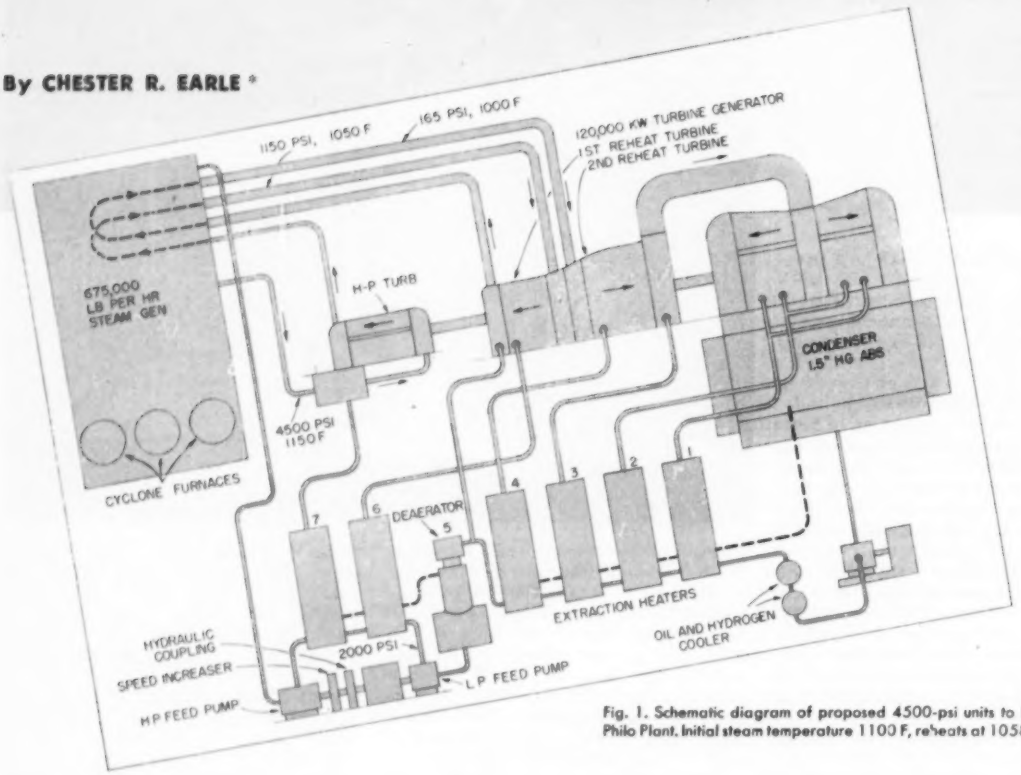


Fig. 1. Schematic diagram of proposed 4500-psi units to be installed at Philo Plant. Initial steam temperature 1100 F, reheats at 1050 F and 1000 F

TWO OUTSTANDING developments occurred in the power field in 1953. First was the decision of AEC to build an atomic energy plant solely for the production of electric power. Second was the decision to break through the critical steam pressure barrier and build a commercial steam power plant to operate at 4500 psi, 1150 F steam conditions.

Importance of the atomic power plant development has been discussed in a preceding article in this issue. But the importance of the second development to the entire power field is not quite so obvious.

Immediate advantages of the supercritical pressure development are: 1) it will push power plant efficiency up another 2 to 5 per cent; 2) it leads to use of compact, once-through, universal-pressure steam generating units, accompanied by elimination of large, expensive boiler drums.

Why supercritical pressure? — For some years now, steam pressures and temperatures have been edging gradually upwards. Steam conditions of 1250 psi, 950 F became common several years ago for new utility plant units, although in industry there are still only a handful of such plants. But a couple of years ago, utilities began to install units for pressures of 1800, 2000, 2300 psi, steam and reheat temperatures of 1000 F and 1050 F.

Several machines are now operating at 2000 to 2400 psi and 1000 or 1050 F and there will be 1100-F machines on the line in 1954. With fuel costs showing no disposition to fall, further increases in thermal efficiency will be in small increments.

Several modern utility units are operating at heat rates of a little over 9000 Btu per net kwh corresponding to over-all thermal efficiencies of around 36 per cent.

But now, as steam pressure edges up, it approaches the critical point, 3206.2 psi, at which density of steam and water are equal, Fig. 2. Why not forget about increments and take the broad jump over the critical pressure up to regions of 4500 or 5000 psi and 1150 or even 1200 F?

Water and steam densities: — Such a big step is necessary to make a big gain in efficiency, for the following reason. As pressures approach 3206.2, the critical pressure, separation of vapor from water in the steam generator requires steam

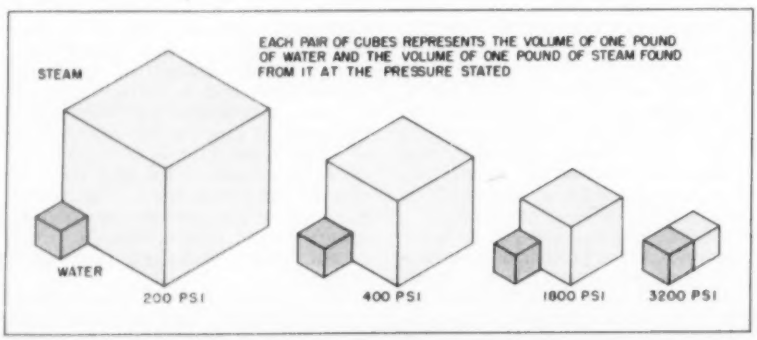

EACH PAIR OF CUBES REPRESENTS THE VOLUME OF ONE POUND OF WATER AND THE VOLUME OF ONE POUND OF STEAM FOUND FROM IT AT THE PRESSURE STATED
STEAM
WATER
200 PSI
400 PSI
1800 PSI
3200 PSI

Fig. 2. Diagram showing relative volumes of water and steam at various pressures. They are equal at 3206.2 psi, hence no water level is observable for at this critical pressure densities are the same

* Managing Editor, Power Engineering

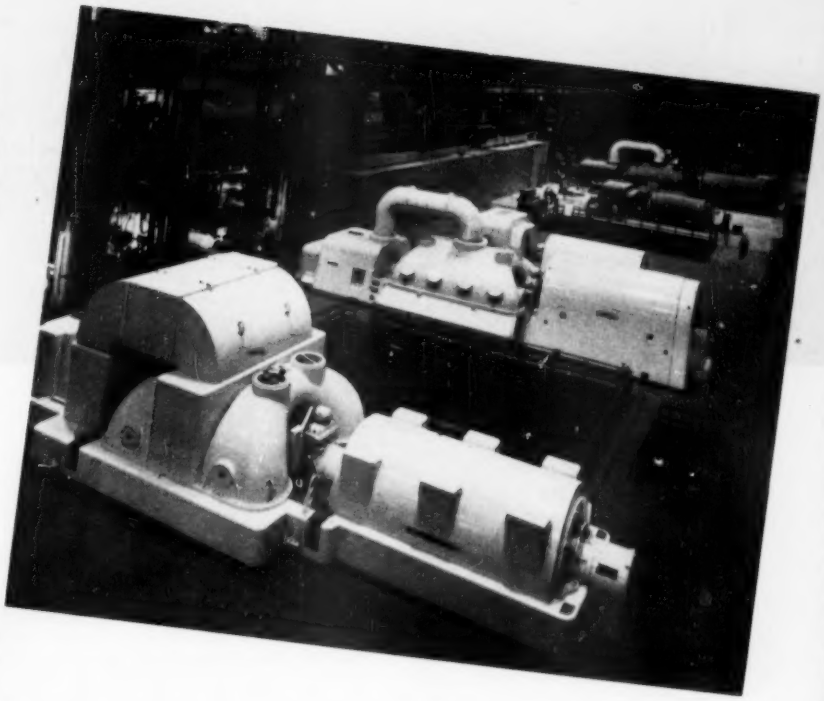


Fig. 4. Here are the 150,000-kw turbine generators installed at Ridgeland Station in Chicago, for comparison with Fig. 3. In foreground, low-pressure element of one 150,000-kw unit; center, complete h-p and l-p elements of a second 150,000-kw unit; background, third similar unit under construction, scheduled for operation in December

drums 30 or 40 ft long, with walls 6 to 9 in. thick, also great height of unit to drive the circulation.

This is a result of the small difference between vapor and liquid near and below critical pressure. Forced circulation relieves the height requirement but introduces pump problems. Yet it would be difficult

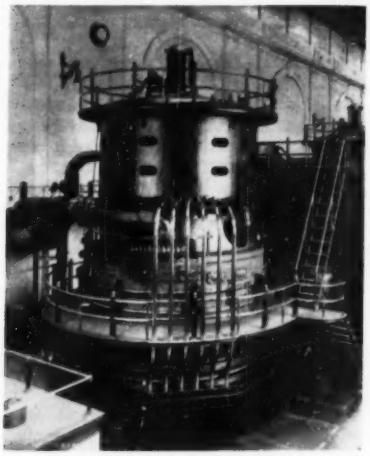


Fig. 3. Here is the first 5000-kw turbine generator in the U. S., installed at Fisk Station in Chicago in 1903, now in its builder's yard at Schenectady inscribed for posterity "Monument to Courage"

to operate exactly at the critical pressure, for small dips in pressure below 3206 would throw the vapor back into solid water, bad for all equipment, and the situation would compare with operating a turbine or airplane at critical speed.

At pressures above critical, the change from water to steam is a continuous process as heat is added. No drum is needed for separation; there is no boiling or bubbling action as the steam is generated. Water at high pressure can be pumped into one end of a tube arrangement that may consist of multiple paths, and at the other end, superheated steam will discharge. No steam drum will be needed.

Philo 4500-psi unit: — Based on these ideas, a new unit of 120,000 kw capacity is being designed for installation at the Philo Plant of American Gas & Electric Co., as announced in our July 1953 issue, page 68. This unit will replace a 40,000-kw, 600-psi unit installed in 1924 (see *Power Plant Engineering*, June 1, 1925).

The new unit is designed to operate at 4500 psi, initial steam temperature 1150 F, with two stages of reheat at 1050 F and 1000 F. See Fig. 1. It is expected to operate at a heat rate of about 8500 Btu per kwh, corresponding to an over-all thermal efficiency of 40.1 per cent, highest to be reached so far in a condensing plant.

Steam generator for this new Philo unit will be of the once-through type, called a universal-pressure unit, in which parallel tubes act like one long tube.

Three cyclone furnaces will fire the unit with crushed coal; gas recirculation will be used. Steam generator pressure will be controlled by feed pump discharge pressure, which in turn will be governed by control of the feed pump speed from the turbine throttle.

Turbine generator will be a 3-element 3600-rpm single-shaft machine, Fig. 1, with two reheat points and extraction points as shown. Intercept valves on each of the reheat lines will protect the turbine in event of trip-out.

Austenitic materials will be used for stop and control valves, steam leads and various h-p turbine parts. Steam temperature controls will protect the turbine against carryover. Condenser will be 2-pass.

Additional studies: — Another manufacturer is making a study of a 200,000-kw, 5000-psi turbine with 1200 F initial temperature and two reheats. Compared with a 2000-psi, 1100 F/1050 F unit, it should show a gain in over-all efficiency of 5 to 6 per cent.

With existing fuel prices in some areas, it is claimed that a utility can afford to invest about ½ of a million more in a 200-mw plant to gain 1 per cent in efficiency.

One big problem in the critical pressure plant is feed pump power, which rises sharply as boiler pressure rises. In the new Philo unit, feed pump work is estimated at about 4 per cent of the total power generated. However, another company estimates that a 200-mw 5000-psi boiler with conventional pump drive would require 14,000 hp — about 7 per cent of total output.

Another development during the year is investigation by one American manufacturer of the use of the monotube steam generator in this country (see August issue, page 69). It is a once-through, drumless, forced-circulation type, and has been used in many power stations abroad. It can be built for small or large capacities and for high pressures and is being studied now for possible use in the United States at supercritical pressure.

Boiler progress: — Conventional gravity and forced circulation boiler units continue to be installed for large capacities and high pressures and temperatures. A recent 2650-psi 1100-F unit at Kearny Station is an example. Steam generating units of over 1,000,000 lb per hr capacity are becoming common and one of 1,600,000 lb per hr is being planned. Of two 2000-psi steam generators now being designed for Detroit Edison's projected River Rouge plant, one will

Fig. 5. Recent view of Joppa Steam-Electric Station of Electric Energy, Inc., showing two of the 150,000-kw units, now in operation, with third under construction and a fourth soon to be added. Station completely outdoor design, boilers at right, switch-yard at left

have natural circulation, the other forced circulation.

Two of the largest turbine generator units yet to be built — each of 250,000 kw capacity — are now being designed. Several stations are being designed for ultimate capacities of over 1,000,000 kw.

One of the interesting events of 1953 was the observance of the 50th anniversary of Commonwealth Edison Co.'s historic Fisk Station in Chicago. There, in 1903, was installed the first large steam turbine generating unit in the United States. From this pioneer unit, Fig. 3, development of turbine generators has continued until today we have the 150,000-kw giants at the Commonwealth Edison Co.'s latest station, Ridgeland, shown in Fig. 4.

About 27,000,000 kw of generating capacity is being scheduled to begin operation in 1953, 1954 and 1955. About half of these units will use reheat, which is being adopted widely after being introduced 25 years ago and not taken up again until steam temperatures reached a new high plateau at around 1000 F.

Among the new stations of the next 2 or 3 years will be some 100 semi-outdoor or completely outdoor plants. Another interesting design factor is location of a number of plants where cooling towers will have to be used: examples, Etiwanda, Vermillion.

Firing equipment: — Cyclone-furnace units are also coming into wide use. Pressurized furnace design is used in many of the new conventional units, where its practicability has been well demonstrated now that methods have been developed to overcome certain operating troubles. These arise mostly from differential expansion of parts of boiler and casing, also from necessity for proper soot blower seals and other items. They were discussed in detail in the June 1953 issue, p. 92.

Pulverized coal fires most utility boilers, although oil and gas are often burned and are available in some locations. Much work is being done to improve boiler and furnace performance, especially in coal-burning furnaces, where slag screens, divided furnaces, cyclone furnaces and the like are being used. A newer development is the partition wall, tube curtain or platen, extending into the furnace to receive heat from both sides to coal combustion products below ash-softening temperature.

At Oak Creek Station, three partition walls along the front wall form four semi-cells between down burners. These not only absorb heat but permit differential firing to aid steam temperature control.

Boiler tube deposits: — These are still a problem. A specially-designed pellet gun (May 1953 issue, page 74) has been developed for cleaning high duty furnaces and those using low-quality fuel. In at least one test plant, cleaning by these pellet guns produces a large increase in heat absorption of the boiler surfaces.

For low-temperature deposits and corrosion in air preheaters, air may be recirculated or the entering air may be warmed by steam air heaters. Special glass tubing is being tried in the condensation region of air heaters.

Industrial modernization: — In the industrial power and steam plant, modernization is the big word today, rather than expansion, although many new industrial steam plants are being planned. Package type boilers — May 1953 issue, page 36 — and standardized types of larger units up to 100,000 lb per hr capacity — November issue, page 58 — are finding wide acceptance. Firing by oil and gas is on the increase, especially where new pipelines are bringing gas into areas not hitherto served.

Coal remains our principal fuel, however, and the spreader stoker maintains its lead in most new industrial and a few utility coal-burning installations. A new type spreader stoker with reciprocating grates, discharging at the front like the traveling grate type, is attracting considerable attention.

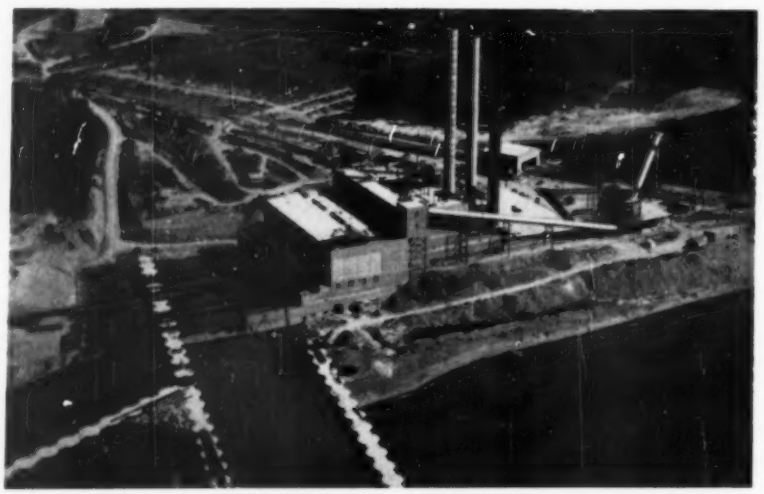


Fig. 6. General view of new Eastlake Power Plant of Cleveland Electric Illuminating Co. First 125,000-kw unit is operating, second was scheduled for December '53. Ultimate capacity will exceed 1,000,000 kw

Fig. 7. Control of operation of new 117,000-kw Murray Gill generating station of Kansas City Gas & Electric Co. is centralized at this diagrammatic panel, using many miniature instruments. It controls a 47,000-kw unit and a 70,000-kw unit

Typical of a number of recent industrial power plant modernizations was the one at Hawthorne plant of Western Electric Co., May 1953 issue, page 86. Another has just been completed by Goodyear, see Fig. 8. Small plant modernizations were covered by H. D. Fisher in June issue.

Average capacity of industrial turbine generators sold by one manufacturer has risen to around 4000 to 5000 kw. And there are, of course, many thousands of smaller generator and small mechanical drive steam turbines.

Centralized control: — Pros and cons of centralized control of power plants, miniature instruments and diagrammatic panels are still being debated this year. There has been further discussion of color coding of instruments. First few diagrammatic control panels have been installed in utility plants, but a most outstanding installation (using miniature instruments) was at Western Electric's Hawthorne plant (May issue).

Diesels: — In the diesel field, the dual-fuel engine continues to dominate wherever gas supplies are available. The radial diesel engine, burning gas, is used in large installations of 80 and 120 engines at large aluminum company plants in the South. In one case a battery of 80 of these engines plus 15 large steam turbine generators will supply power.

Smaller installations of radial diesels, such as the two at Milaca, Minn. (July issue, page 58) and another in Michigan, are reported as giving good service with low maintenance.

Gas Turbines: — Progress in gas turbine development continues. As of November 1953, there were 10 locomotives, 15 electric power generation units and 35 gas line pumping units installed in the United States, according to Kottcamp. These gas turbines, as of August 1953, had a total operating time of approximately 170,000 hr.

Several of the locomotives and most of the stationary electric generating units have been fired by residual fuel oils and the vanadium and sodium components of the fuel-oil ash have led to nozzle and blade corrosion and deposition in some cases.

Specifications for residual fuel oil to minimize these troubles have been set up (August 1953, page 108) and one oil company, working with railroad and gas turbine manufacturers, has had considerable success in supplying such oil for locomotives.

But such modified oil costs a bit more (about ⅛ cent per gal) and is not yet readily available everywhere. Hence a more recent development, the use of propane gas, is arousing much interest.

Work continues on the coal-burning gas turbine locomotive of the LDC at Dunkirk, N. Y. As reported in June issue, page 87, a 750-hr test of this unit was completed, some blade erosion was found and further work on the ash separator was necessary. Test efficiency was a little over 20 per cent, and the unit's operation justified a cooperative working agreement between LDC and American Locomotive to accelerate work.

Hydroelectric: — Proposed units for pumped storage developments hold the center of interest in the hydroelectric field. A model of the Hiwassee reversible pump turbine of 102,000 hp (February 1953 issue, page 59) is now being tested.

For the proposed Niagara Falls development, reversible pump turbines are also being considered for the pumped storage part of that development.

Work is going forward also on construction of the Kitimat project for aluminum production in British Columbia. Here an underground power plant in solid rock is designed to contain 16 vertical-shaft 150,000-hp impulse turbines operating at 2300 ft head. First of these turbines was scheduled to go into operation in November 1953, another early in 1954, and others to follow shortly.

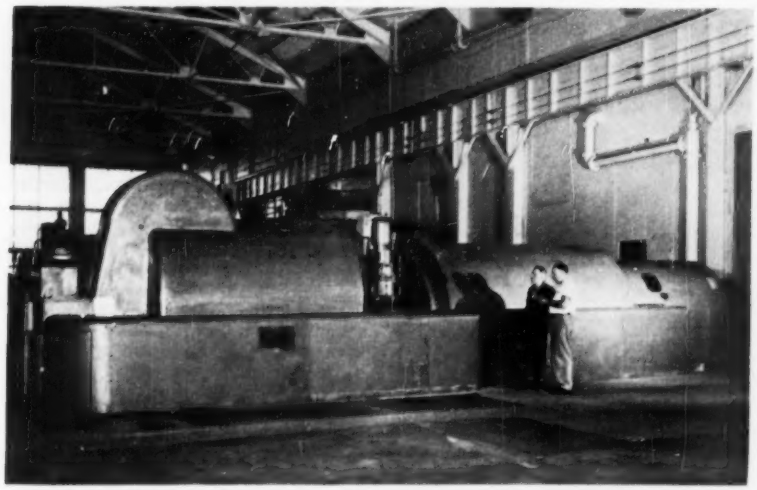


Fig. 8. This 12,500-kw turbine generator, served by two 974-psi, 835-F. pulverized coal-fired boilers, was installed recently as part of an extensive modernization of Goodyear's power system at Akron

Electrical Development Seeks

Electrical development continues at an amazing and accelerating pace and while limitations that seemed to restrict progress a few years ago have been overcome, new ones loom up with respect to future achievement. Switchgear of 40 million kva interrupting capacity in sight but further development depends upon discovery of new principles

ECONOMISTS and statisticians who predict the future growth of electrical development have easier jobs than the would-be prophets who try to foretell the technical progress of the industry. History does provide the statistician with data with which to predict how the electrical load or the use of power may grow in future years but in the technical field the only conclusion that can be drawn from a study of past developments is that *almost anything can happen.* In technical matters it is unsafe to make any predictions unless they are heavily colored with imagination — almost reckless imagination. We have reached a point where the comics seem to provide a better guide to future development than the profound knowledge of specialists who, too often, are hampered by knowledge of what *can't be done.*

Dr. Alfred North Whitehead the philosopher once pointed out that it takes a genius to see the obvious. Even a genius fails at times as is evident in Edison's failure to grasp the significance of the Edison Effect when he was experimenting with the incandescent lamp. Edison noted that a plate placed within the evacuated carbon filament lamp became charged electrically and that when he connected the filament with the plate, a current would be established in the connecting wire. Even Edison, with all his imagination, did not realize that in this curious, then unexplained effect lay the basis for the whole far-flung radio and electronics industry of today. So it need not be surprising to find that even with our much greater background of knowledge, we ourselves cannot see very far into the electrical future. The rate of progress is so fast that it is impossible for any one person to keep abreast of developments.

The year 1953, like the other years since the war, was a year of continuous, intensive, and accelerating development in all branches of the electrical art. Its achievements ranged all the way from the production of 250,000-kw single-shaft generators to tiny motors of less than two watts rating controlled by small vacuum tubes. In the communication field, the year's developments included a world-wide radio station with antennas stretched between mountain ranges as well as a miniature wrist-watch-size transmitter first featured in the Dick Tracy comic strip. The scope and variety of new developments and new techniques is truly astonishing. At the Bureau of Standards a new automatic manufacturing technique was developed whereby electronic equipment is produced from raw materials completely without human intervention. At the Bureau also, a newly developed cesium-beam atomic clock operates with a precision of one part in 10 billion.

In the electric power branch of the field generator capacities not only went to higher values than ever before but developments in methods of cooling, in the character of insulation, and bushing design make machines of far greater capacity possible. With liquid cooling of generators, about 15 times as much heat can be removed from the copper as with conventional helium cooling. In combination with such advances as direct gas-cooling of the rotor, and grain-oriented steel, engineers are building a 3600 rpm, 260,000-kva generator in a frame size considerably smaller than previous 220,000-kva machines.

Until quite recently it appeared that one of the limiting factors in electric generator design was the bushing rating, which seemed to be limited to around 6000 amp. A recent development in bushing design using a jet cooling system now makes it possible to quadruple the current carrying capacity. This system developed by Allis-Chalmers forces high-velocity hydrogen gas through the bushing. Tests indicate that with this method of cooling, a 4500-amp bushing can safely carry 17,500 amp at 30 psi hydrogen pressure.

Transformer development is quite as important to the industry as is generator development since for each kva of generator capacity needed *more* than one kva in transformer capacity is required. Voltage not only has to be stepped up, it also has to be stepped down. Growth of the annual power consumption to a trillion kilowatt hours in 1965 will mean doubling the total kva capacity of power transformers in service. In transformer design, grain orientation of transformer steel has been even more important than in generator design and during the past 18 years it has reduced the size and weight of transformers by over 60 per cent.

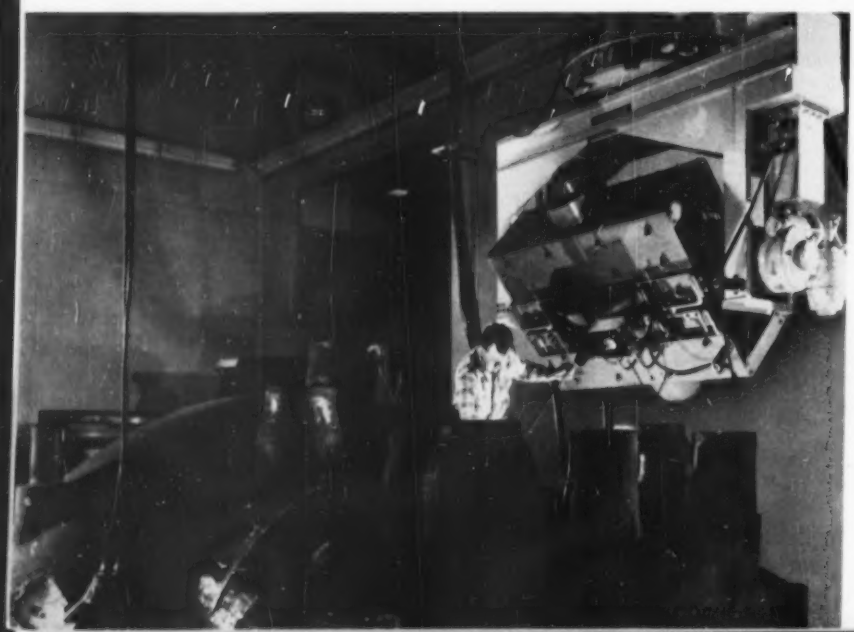


Fig. 1. Radiographic inspection of 125,000 kw turbine casing at the plant of Allis-Chalmers Mfg. Co. with 22 million volt industrial betatron

New and Wider Frontiers

Fig. 2. A secondary winding is shown being placed on a General Electric precut, preformed transformer core made of oriented, cold-rolled silicon steel. This preforming method provides greater flexibility in designing large power transformers

New advances in x-ray technique are making possible more certain inspection of heavy turbogenerator equipment. At Allis-Chalmers Mfg. Co. a 22-million volt industrial betatron is used for such inspection. Any minute flaw that might exist — one only a few thousandths of an inch — will be revealed even if locked deep in the 5- to 18-inch thickness of a turbine casing. With the high-voltage betatron this is now done in minutes rather than the hours or days required with lower voltage x-ray machines.

The problems of the switchgear designer multiply and become more important each year as the generating capacity keeps rising. We are now building circuit breakers with interrupting capacities of 25 million kva but these will be inadequate for the energy concentrations that will exist a decade from now. While designers of present-day switchgear foresee no particular difficulty in building breakers of 40 million kva capacity, our present concepts of circuit breaker and relay design are almost certain to be inadequate for future circuits, so new ideas must be brought forth and developed into practical designs over the next ten years.

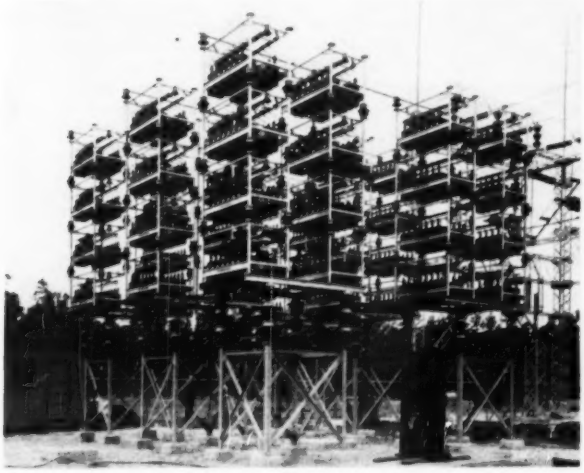


Fig. 3. A stacked capacitor bank. Sets of these factory assembled Westinghouse capacitors can be stacked as many as four high on a set of porcelain supporting insulators

Considerable attention is being given to types of operating mechanisms for high-capacity circuit breakers. Mechanisms have changed over the years to match circuit breaker and industry requirements. There has been an evolutionary trend from manual operation, through various types of mechanisms, including inertia storage schemes and solenoids, to the present spring and compressed-air mechanisms. Recently a hydraulic operating mechanism for high capacity breakers has been developed. This involves a new type of mechanism which depends on a combination of gas and liquid for its energy supply and transmission medium.

In another switchgear development tests were made on a radically new switch which employs magnetic forces to increase the contact pressure with the fault current but no further information is available on this development. For use on high voltage utility circuits for interrupting transformer magnetizing currents, line charging currents, and load currents, where a circuit breaker having fault interrupting ability may not be justified, a new interrupter switch has been developed which combines an air-break main switch with a by-pass interrupter. The latter carries current only during the interrupting interval. Tests on this switch for capacitor switching indicate that banks of 5000 kva at 34.5 kv can be switched 2000 times without interrupter maintenance.

The use of capacitors on transmission systems of all kinds is expanding rapidly. Indeed, three times as many capacitors will be installed during the next 11 years as have been installed to date if the utility load follows its trend of doubling every ten years. The number of improvements in capacitors themselves is unusual but more particularly are the new ways they can be used. New factory assembled stacked capacitors now eliminate the need for building steel frameworks at the site. Four 600-kvar units of this type make a bank of 2400 kvar occupying an area of only 3½ by 9 ft.

The greater use of capacitors on transmission systems has brought forth new problems with high voltage

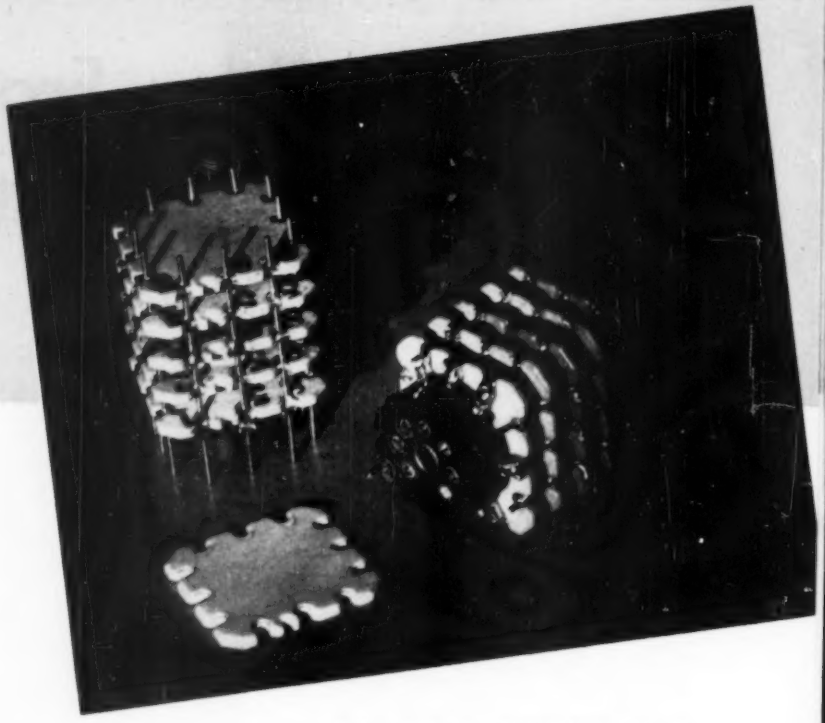


Fig. 4. Modular design of electronic equipment offers dimensionally standardized units having a wide range of functions. Developed by the Bureau of Standards, each module is composed of four to six wafers bearing printed circuits, tape resistors, capacitors, tube sockets and other miniaturized electronic component parts. Tubes are inserted later

conditions during light load periods. To compensate for such voltage rise the switched-capacitor has been coming into more general use. Such automatically switched capacitors are controlled either by voltage or current changes, or by a combination of both. To allow brief changes in load to pass without causing switching operation, time delay is incorporated by settings on induction disk elements similar to those used in demand meters.

The 330-kv transmission line of the American Gas and Electric Co. which went into operation in 1952 remains the highest voltage system in the United States. In Canada, the first transmission line built to operate at 345 kv went into operation last year but initially the line was operated at only 230 kv.

The operation of long, high-voltage transmission systems impose communication problems of considerable importance, and today carrier systems which have been in use for many years are being supplemented by the more recently developed microwave systems. Such microwave systems are less vulnerable to interruption by damage to the transmission lines and also are unaffected by the transmission line characteristics. Carrier systems often suffer considerable loss of energy from resonant conditions which exist as a consequence of certain geometrical relations. In the case of rural distribution systems with radial feeders, it will be found that the feeders will have a large number of taps between ¼ and 1 mile in length. These taps will be equal in electrical length to a quarter wave length at frequencies between 50 kc and 150 kc which are used for carrier supervisory systems. In effect these taps constitute a short circuit for the carrier. To neutralize these resonances it has become the practice to install carrier line traps. Such line traps are usually constructed of inductances in combination with capacitors and resistances, and are placed at strategic locations in the transmission line.

In the field of communications and control one of the brightest stars on the horizon is the transistor, which promises to be one of the major advances in the electrical art and already it has received practical application in various branches of the communication field, particularly in the construction of hearing aids, where compactness is of primary importance. Thus far, the transistor has been a very weak-current device. Within the past two months, however, has come an announcement of a new transistor said to be capable of handling 100 times as much power as present types. This new transistor, according to Dr. Finn Larsen, research director at Minneapolis-Honeywell, where the device was developed, is capable of handling 20 watts, enough to operate small motors, relays, etc.

Perhaps the most astonishing development in the communication field last year was the establishment of an automatic production line for the manufacture of electronic products and a novel system of electronics design by the National Bureau of Standards. The project, code named Project Tinkertoy, was sponsored by the Navy Bureau of Aeronautics. Starting from raw materials, machines automatically manufacture ceramic materials and adhesive carbon resistors, print conducting circuits and mount resistors, capacitors, and other miniaturized components on standard uniform steatite wafers. The wafers are stacked very much like building blocks to form a module that performs all of the functions of one or more electronic stages. Automatic inspection machines clock physical and electrical characteristics of the parts-mounted wafers at numerous stations along the production line. The project was begun by NBS in May 1950 and now successfully produces electronic subassemblies by mechanized means.

Another achievement in the communications field last year was the completion of the most powerful radio-telegraph transmitter ever built for the U. S. Navy. The use of this transmitter will ensure reliable communication with the U. S. Fleet even when high-frequency services are disrupted by magnetic disturbances. It is rated at 1000 kw. Located in the northwest part of the U. S., the antenna system is suspended between two mountain ridges. Currents of 1000 amp in each antenna half are anticipated and the voltage at the top of the helices is expected to approach 200 kv.

Scarcely any branch of the electrical art is not benefiting from developments in other branches. Pulse techniques, for example, received great impetus in the development of radar and in communications generally. Subsequently they came into the welding field as well as in the design of particle accelerators used in nuclear research. Now, it is not surprising to see a pulse technique entering the method of separating suspended particles in gases by electrostatic precipitation. Heretofore in electrostatic precipitation systems the particles were passed between electrically charged plates supplied by steady direct-current sources. In a new system the plates are supplied by a high-voltage, high-power, pulse generator, capable of supplying high-voltage pulses of the order of 100 microseconds' duration at a frequency of several hundred pulses per second. This has resulted not only in a higher precipitation efficiency but also a higher over-all electrical efficiency.

Fly Ash May Yield Commercial Germanium

Germanium transistors are the key to miniaturization and power economy in electronic devices. Studies of thirteen boiler installations in six power plants indicate that fly ash may hold the keys to large scale production of this promising element

ONE LARGE manufacturer has brought out a miniature two-way radio closely resembling a hearing aid. Another manufacturer has developed an automobile radio that operates on less power than the dial light requires. Still another company has introduced a hearing aid that uses only fifteen cents worth of battery power a month. All of these domestic applications and countless others have been developed around transistors — predominantly germanium transistors.

The potential market for these domestic appliances, plus the military and industrial devices made possible, is tremendous. With demand threatening to exceed the supply from our present sources of germanium, it has been suggested that the fly ash from coal-burning power plants be developed as a commercial source of the material.

Preliminary investigations of this idea have been conducted by the Bituminous Coal Utilization and Preparation Branch and the Health Branch of the U. S. Bureau of Mines in cooperation with the Army Signal Corps Engineering Laboratories. Results of these studies were reported in a paper presented by R. C. Corey at the recent AIME-ASME Joint Fuels Conference in Chicago.

Germanium Volatilized

Of the many facts accumulated in this new field of study, perhaps the most important was that most of the germanium present in the coal is concentrated in the fly ash upon combustion. In many cases, no measurable amounts were found in the other solid products of combustion. Though it was carefully pointed out that this did not mean that there was none present in those other products, it is apparent from the small quantities detectable by their apparatus that traces below the range of detection were quite small indeed.

While the germanium content of coal as fired varied between 2.4 and 9.0 ppm, samples of fly ash from dust collector hoppers contained from 15 to 60 ppm. Thus, the combustion process caused an enrichment or concentration of the metal ranging between 3.3 and 18.7 to 1. Most of the enrichment ratios fell between 6 and 8 to 1.

There is reason to believe that germanium is volatilized as an oxide (GeO) during combustion and later condensed in a higher valence form (GeO_2) on the fly ash particles. This is, at this time, a supposition supported by some observed facts — but it has not been definitely proved.

Researchers on this project have tentatively concluded that most of the germanium is associated with finer particles in fly ash — the size of 20 microns representing the probable upper limit for significant concentrations. Two possibilities are advanced to explain this condition (still assuming, of course, that it is true). The first is that the smaller particles present a greater surface area for their mass than large particles and that condensation is closely related to available condensing surface. The second possibility is that the smaller particles will remain longer in the flue gas of those installations employing electrostatic precipitators. In this regard, investigators noted that in at least one instance the particles removed in the early stages of separation were the larger sizes.

One of the strongest reasons advanced to support the theory that germanium is volatilized and subsequently condenses on fly ash particles developed out of observations made of cyclone and chain-grate furnaces. In both cases, a relatively small proportion of ash is discharged as dust. One sample of dust from the cyclone furnace showed 290 ppm of germanium and one sample from the chain-grate furnace showed 530 ppm. It was pointed out that volatilized germanium would naturally appear in greater concentrations if it condensed on less ash.

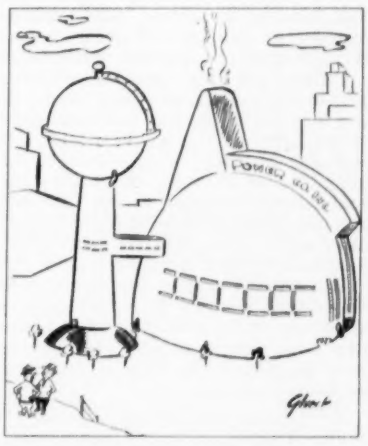
A slag-tap furnace, likewise a low-dust type, was found to maintain a relatively high average concentration of germanium in the fly ash despite the fact that much of the available germanium was trapped with the slag. Again, this is an indication that germanium volatilizes and precipitates on the available ash nuclei.

Crude germanium tetrachloride is being produced from flue dust by the British at this time. The process consists of smelting the dust and trapping the rare elements in crude form or impure metallic slags. This is dissolved in ferric chloride solution with the aid of chlorine, and the resulting germanium tetrachloride is distilled off. Purity of the distillate is improved by fractional distillation and rectification in a packed column.

Germanium Extraction

In this country, the principal present source of germanium is the zinc smelter. Mr. Corey pointed out that Eagle-Picher Company developed a metallurgical process to extract germanium from the by-products of such smelters. They presently supply both germanium and germanium dioxide.

While the Eagle-Picher process will doubtless continue to be used, zinc ore concentrates are limited. Since the potential demand for germanium is virtually *un*limited, it appears likely that the electronics industry must turn ultimately to the power plants for their raw materials as well as power for their gadgetry.



"So what's wrong with the design — comes the atomic age we'll be all set."

Paul J. Grogan's* Graphical Solutions for Power Engineers

Fuel Cost Comparisons

SELECTION OF FUELS should be based on several prime considerations including availability, adaptability, and simple economics in terms of dollars and cents. It is in discussing the last of these considerations that there is need for a simple and direct basis of comparison. Unfortunately, there is no common denominator upon which the costs of different fuels are based. Coal is priced at dollars per ton (long or short); oil is priced at cents per gallon or dollars per barrel (42 gallons); gas at cents per thousand cu ft or per 100,000 Btu.

The chart "Fuel Cost Comparisons" was prepared to give an instant, graphic comparison of the cost per million Btu for the various types and probable price range of common power fuels. Fuels of different types are easily compared. Two or more fuels of the same type, but with different heating values and costs, can be compared to determine which is actually the more economical.

Derivation of the Comparison Chart

Graphical relations on the comparison chart are represented by straight lines, which greatly improve construction accuracy and aid in reading the chart. The use of logarithmic coordinates allows the construction to be made and read throughout the range with the same percentage accuracy.

Delivered cost of coal can be expressed as:

$$C = \frac{100(D) \times 1{,}000{,}000}{2000(HHV)} = \frac{50{,}000(D)}{(HHV)}$$

where D = dollars per short ton, C = cents per million Btu, delivered, and HHV = higher heating value (Btu per lb). Assuming a 12,000-Btu coal which is available in different locales at $6.00, $12.00 and an extreme $18.00 per ton, the delivered cost is:

$$C = \frac{50{,}000(6)}{12{,}000} = 25 \text{ cents per million Btu,}$$

$$C = \frac{50{,}000(12)}{12{,}000} = 50 \text{ cents per million Btu, and}$$

$$C = \frac{50{,}000(18)}{12{,}000} = 75 \text{ cents per million Btu.}$$

The points, if plotted, will fall along the 12,000-Btu coal line on the chart. This confirms the straight-line relation of the factors in the equation. Each of the HHV lines can be checked in this manner.

Oil and gas Btu costs are also straight-line functions of heating value and unit cost. By proper selection and location of the unit cost scale for those fuels (bottom of the page), it is possible to utilize the coal lines for oil and gas heating values, though they are different in magnitude and units. (Note that the 13,000-Btu-per-lb coal line is the same as the 1300-Btu-per-cu-ft gas line and the 130,000-Btu-per-gal oil line.) In this way, the number of lines on the chart can be reduced while maintaining both accuracy and simplicity.

Ultimate fuel cost for the absorbed heat energy is dependent on the delivered cost and the absorption efficiency of the boiler or other heat exchanger. Though this is a simple division mathematically, it is shown here graphically to help in comparing ultimate as well as delivered costs.

This division is done graphically as follows:

a. From the point of intersection of the unit cost and HHV lines, draw a line horizontally to intersect the "100 Per Cent Reference Line".
b. From this point, draw a vertical line to intersect the line designating the known absorption efficiency.
c. From this third point, draw a line horizontally to the right to intersect the "Ultimate Cost of Energy" scale. The point of intersection gives the cost in cents per million Btu absorbed.

Examples

Example 1. Assume that a 12,000-Btu coal is available to you at $8.00 per ton, delivered. If your past experience indicates an absorption efficiency of 70 per cent, what would be the cost per million Btu delivered? What would be the cost per million Btu absorbed?

Solution 1. Find $8.00 per ton on the coal scale and construct a vertical line (A) to intersect the 12,000-Btu coal line. Next, construct a horizontal line (B) through this point to intersect the "Delivered Cost" scale.

Answer 1-a: 33 cents per million Btu, delivered.

To find the cost of absorbed energy at 70 per cent absorption efficiency, project a line (C) through the same point horizontally to intersect the "100 Per Cent Reference Line." Erect a vertical line (D) through this point to intersect the 70-per-cent-absorption line, then through the point of intersection draw another horizontal line (D) to intersect the right-hand ordinate, or "Ultimate Cost" scale.

Answer 1-b: 47.5 cents per million Btu absorbed.

Example 2: Assume that a fuel oil is available at 9 cents per gallon delivered and that it has a HHV of 150,000 Btu per gallon. Assume that this fuel can be burned at 80 per cent absorption efficiency. Find the ultimate cost per million Btu absorbed.

Solution 2: Find 9 cents per gallon on the oil scale and construct a vertical line (F) to intersect the 150,000-Btu oil line. Through the point of intersection, draw a line (G) horizontally to intersect the "100 Per Cent Reference Line." Through this point, erect another vertical line (H) to intersect the 80-per-cent-absorption line. A final line (I) drawn through this point horizontally to the "Ultimate Cost" scale gives the answer.

Answer 2: 75 cents per million Btu absorbed.

Having followed the two preceding examples on the chart, solve the following example to check your proficiency.

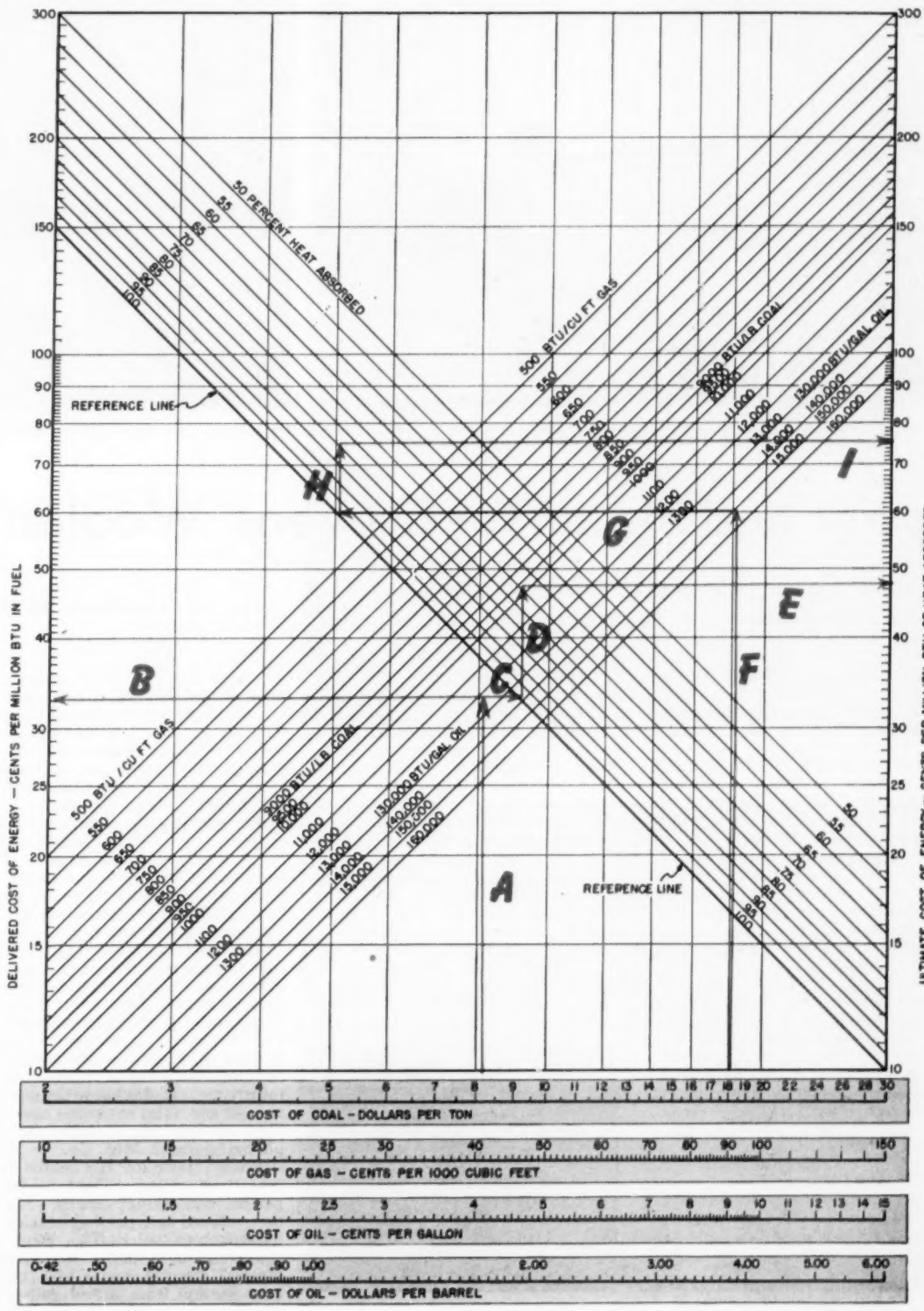
Example 3: Assume that a 1000-Btu-per-cu-ft natural gas is available at 70 cents per thousand cu ft. Assume also that the absorption efficiency is the same as for the preceding oil-fired installation (80 per cent). Find the ultimate cost per million Btu absorbed.

Solution 3: Find 70 cents per thousand cu ft on the gas scale and construct a vertical line (label it J) through that point to intersect the 1000-Btu-per-cu-ft gas line. Next, construct a horizontal line (label it K) through the point of intersection to intersect the "100 Per Cent Reference Line." Through this point, erect a vertical line (label it M) to intersect the 80-per-cent-absorption line. From this point of intersection, draw a horizontal line (label it N) to intersect the right-hand ordinate or "Ultimate Cost" scale. The point of intersection of that scale by line N should agree with the following answer:

Answer 3: 87.5 cents per million Btu absorbed.

* Chairman, Department of Engineering, and Director of Engineering Institutes, University Extension Division, University of Wisconsin. All republication rights reserved by author.

Delivered and Ultimate Fuel Cost Comparison Chart



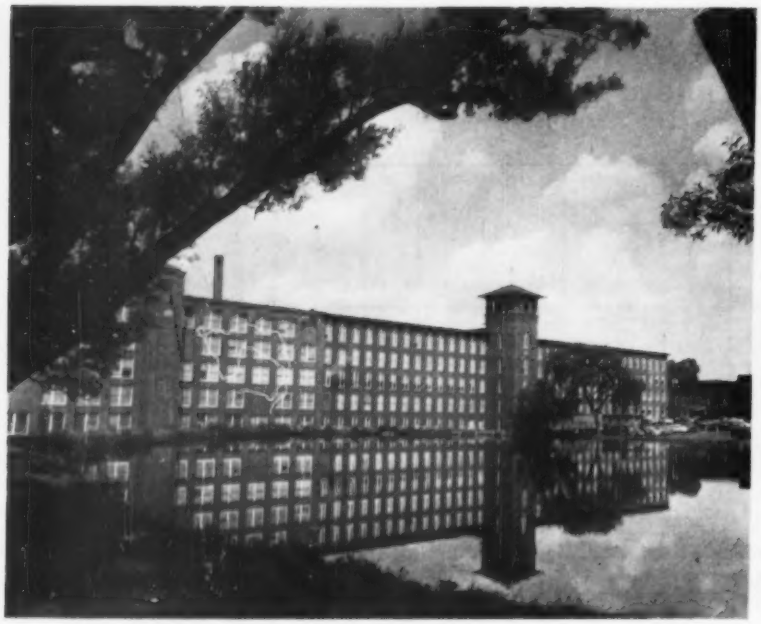


Fig. 1. The textile mill of M. T. Stevens & Sons Co. at North Andover, Mass., has this country setting

Fig. 2. Three 333-kva, 4160/600-v. transformers

Power and Steam for Stevens' Woolens

How textile process rearrangement changed steam and power balance at North Andover, Mass. mill of M. T. Stevens & Sons Co.

By FREEMAN C. HATCH*

STEVENS MILL at North Andover has long been outstanding among the mills that make New England famous for textiles. This mill, where M. T. Stevens & Sons Co. has manufactured fine woolen cloth since 1813, is part of the northern division of J. P. Stevens & Co. Inc. Several other mills comprise the northern division.

Rather recently, because of a reorganization of the company, the operations of the northern division were rearranged and the various processes have been segregated. The wool preparation processes formerly carried on at the North Andover mill required 40,000 gph of hot water for process work, 18,000 lb per hr of process steam, and about 450,000 kwh of electricity per month. These wool preparation processes have now been transferred to the company's mill at Franklin, N. H., so that the hot water and process steam are no longer needed at North Andover.

The power plant, located behind the main mill building, contains two boilers, the necessary auxiliaries and a 750-kw back-pressure steam turbine generator, formerly producing electric power and process steam for the mill but now shut down and held for standby. All electric power is now purchased from the local utility.

The two boilers, Fig. 5, are Heine (now Combustion) water-tube units of 20,000 lb per hr capacity each, designed for operation at 225 psi, and 100 F. superheat, but operated now at 160 to 185 psi saturated. They were reset in 1952 and their solid refractory furnaces enlarged and redesigned so they can burn either oil or pulverized coal. The normal base load fuel is Bunker C oil; coal will be burned only in case of extreme emergencies.

Each boiler is equipped with two E. F. Woolley Co. combination oil and coal burners, Fig. 5. The fuel oil is delivered in tank cars and stored in underground storage tanks outside the boiler plant. From these tanks it flows to the fuel oil pump suctions. These pumps deliver the oil through Woolley fuel oil heaters, Fig. 6, to the burners. One pump is a De Laval centrifugal oil pump driven by a 3-hp U. S. motor; the other is a Warren reciprocating steam pump.

Fig. 3. Two unit pulverizers for emergency firing

For standby or emergency firing of coal, two Woolley pulverizers, Fig. 3, are held in readiness on skids at one side of the boiler room and these can be quickly moved up to the boiler fronts and connected to the combination burners.

Coal cars can dump into an outdoor coal storage area behind the plant or into a track hopper that loads a continuous bucket elevator to carry the coal into the plant and discharge into two coverhead steel coal bunkers. The elevator can also handle ash, and as it leaves the top of the plant on its return run, can discharge the ash into an ash silo. The complete coal-handling system was installed by Stephens-Adamson Mfg. Co.

Boiler feedwater is heated in a recently-installed Elliott 60,000-lb-per-hr deaerating heater, Fig. 4, using steam at 7 psi and heating the feedwater to 230 F. Two Worthington centrifugal boiler feed pumps, located directly under this heater, take suction from it and deliver the water to the boilers. Each pump has

*Engineering Department, in charge of power and construction work, M. T. Stevens & Sons Co.

Fig. 4. New deaerating heater and feed pumps

a capacity of 60,000 lb per hr; one is driven by a Worthington 30-hp 3540-rpm steam turbine, the other by an Allis-Chalmers 30-hp 3540-rpm motor.

Combustion air for each of the boilers is supplied to the burner windboxes by a Buffalo Size 4 forced draft fan, Fig. 5, installed at the boiler fronts, and driven by a 5-hp U. S. motor.

A complete sprinkler system is installed throughout the mill. Water for this comes from the city mains. A reservoir on a nearby hill provides emergency water supply. A Worthington centrifugal 1000-gpm fire pump, driven by a 100-hp Westinghouse wound-rotor motor, is installed for this service.

All electric power for the mill is now purchased from the Lawrence Electric Co., which is the local operating utility of the New England Power System. Power is delivered to the plant substation at 4160 v and the bank of three 333-kva transformers shown in Fig. 2 steps it down to 600 v for delivery to the mill over the two 500,000 circular mil cable sets shown.

Mill power distribution is at 600 v, with stepdown transformer stations in the mill where required, to reduce voltage to 110 v for lighting. Many of the motors driving the textile machinery are 600-v wound-rotor motors to provide required starting torque for cards.

Power and construction work are supervised by Freeman C. Hatch, the author of this article. Eddie Main is master mechanic of the mill, Peter Stolker is production superintendent and John F. Mathews is engineering department manager.

Fig. 5. General view of the two 20,000-lb-per-hr oil-fired boilers now in the Stevens Mill power plant

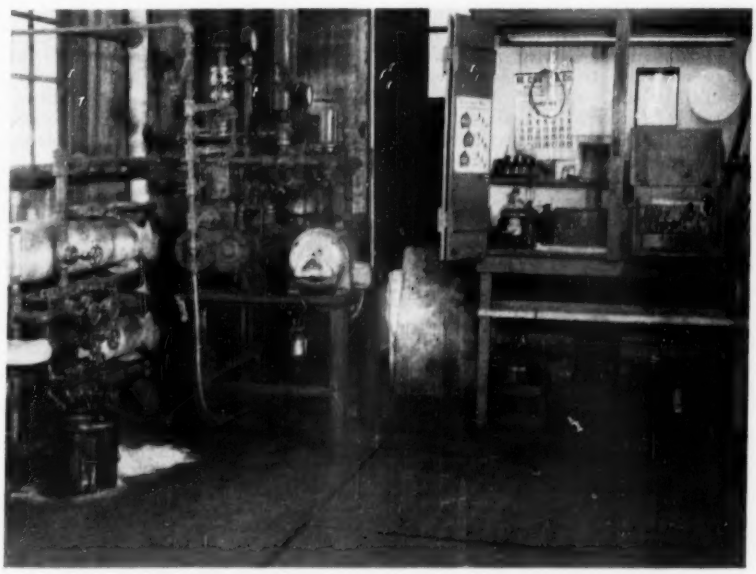


Fig. 6. At left under window, fuel oil heater and oil supply pumps. At right is the feedwater test kit

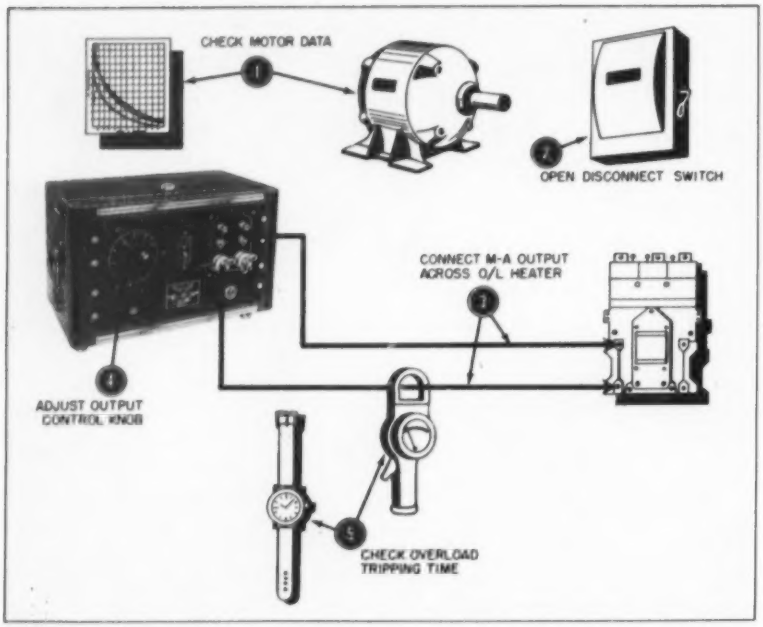


Diagram showing steps to be followed when using test set to check and calibrate motor overload relays

Now You Can Test Your Motor Overload Relays

Here's why your motor overload relays may not be giving you proper protection and how to make regular trip current tests

By **MELVIN S. COBEN***

IN SPITE OF all that has been written on the care and maintenance of electrical systems, electrical fires and burned out motors continue to take a large share of the multi-million-dollar maintenance bill. This share should be substantially reduced in future as portable testing equipment is now available for checking motor over-current protective relays quickly, safely and economically, and making sure they do their job properly.

There are many reasons why overload relays may not protect properly. The elements are usually chosen from manufacturers' tables, which are based on average tripping times for average motors and may not fit a particular application. Articles published by leading manufacturers of motor starters and overload relays state quite clearly that the rating of commercial overload relays is at best a compromise, and that their tripping characteristics are selected to protect a majority of the motors in commercial use. There are, however, considerable differences in the actual currents taken by motors of different types and manufacture due to design variations, and it is impossible for the arbitrary selection of overload relays from a table of average values to be anything but a compromise and a guess. Furthermore, thermal overload relays are designed to follow the heating curves of average motors to obtain standardized relay sizes, and this is another compromise.

Motor overload relays are designed so that tripping time varies inversely with the value of motor current. Obviously a proper overload relay should not trip on full load current. Thermal ratings of most motors require tripping in less than 13 sec when the current is 600 per cent of rated current. In-between values of tripping time follow a definite pattern or curve, so that a few tests at selected points on the curve can quickly establish the adequacy of the motor overload protective relays.

For accuracy, each relay should be tested at two or more points on the motor time-current curve; suggested values are 150 and 300 per cent. Ultimate conditions for each motor should be obtained from the manufacturer's data sheet, which will usually give the motor locked rotor current as well as the permissible time for intermediate currents.

If manufacturer's data sheets are not available, the typical calibration table below may be used.

Per Cent Full Load Amps	*Trip Time Minimum — Maximum*
100	....
150	2½ min — 4 min
200	1 min — 1½ min
250	45 sec — 55 sec
300	30 sec — 40 sec
350	25 sec — 30 sec
400	18 sec — 25 sec
450	15 sec — 18 sec
500	13 sec — 17 sec
550	10 sec — 14 sec
600	8 sec — 13 sec

Figures in the above table are calculated to give the average motor maximum protection. In all cases they are conservative.

In order to test motor overload relays, a portable test set, whose operation is described below, is now available.

Motor to be tested is disconnected from the supply, and the test set is plugged into any convenient outlet; the overload relay is connected in series with an ammeter, if one is available, and the outlet terminals of the set; if no ammeter is available, a clamp-type instrument is quite good enough to measure the relay current. Then the test set is adjusted until correct current is flowing through the element. After de-energizing the test set and allowing it to cool it is energized again and the time noted for the overload relay to trip at the current value measured by the ammeter.

Ideal test is one in which actual operating conditions of the motor are accurately simulated. Motors subject to periodic overloading should have their overload relays tested by heating the elements with rated motor current for several minutes and then abruptly increasing the current to the overload percentage. In this way accurate tripping time is obtained for the conditions under which the relay normally serves.

Evaluating Results

If the time taken for the relay to trip exceeds the time indicated in the table, the relay is not protecting the motor properly and the tripping element should be replaced with one having a lower current rating. On the other hand, if this period is less than the minimum time indicated on the table, the motor will be tripped off the line unnecessarily, and the element should be replaced with one having a higher current rating.

*Vice-President in charge of Engineering, Multi-Amp Corporation

How To Figure Performance Curves for Your Liquid Jet Pump

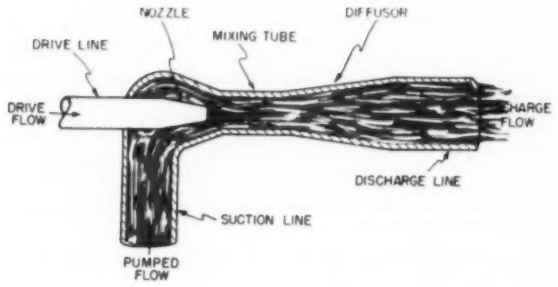


Fig. 1. Diagrammatic section of typical jet pump

By H. W. IVERSEN*

Here are step-by-step directions for constructing, from simple tests during operation, a set of curves for your pump from which you can predict its performance under any operating conditions

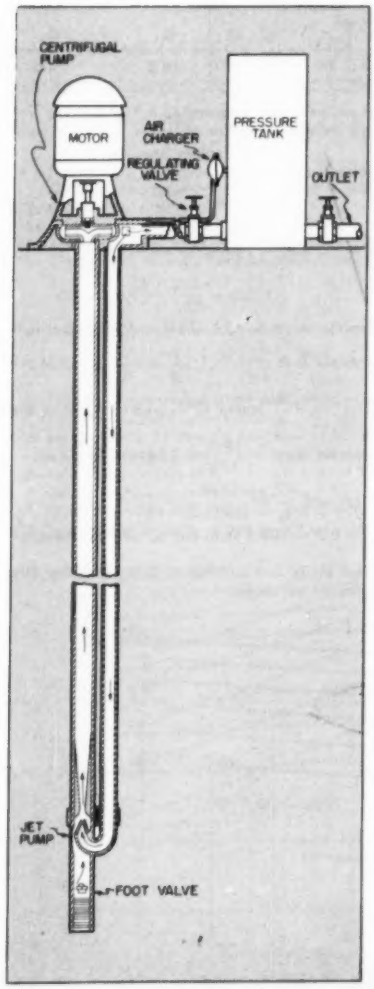


Fig. 2. Jet pump arranged for deep well pumping. With this arrangement all moving parts are above ground and easily accessible, and only the jet pump, which has no moving parts, is below ground

LIQUID JET PUMPS are coming into wider use but the details of their operation are not as well known as many older types, so before describing the construction of performance curves, here are a few words about the operation and application of these pumps.

Their operation is very simple. Referring to Fig. 1, liquid under pressure is forced through the converging nozzle, which it leaves at high velocity. This high velocity jet induces a vacuum in the suction pipe which causes the liquid being pumped to flow up through the suction pipe. The two liquids then flow together through the mixing tube into the diffuser, where, with increased pipe area, velocity drops and pressure increases until maximum pressure and minimum velocity are reached in the discharge line.

One of the great advantages of this type of pump is the absence of moving parts. There are no shafts, impellers or bearings to give trouble, and this simplicity, together with the small size of the jet, make it ideal for sinking operations, so that liquid jet pumps are widely used at present for well-water pumping. A typical arrangement is shown in Fig. 2. Where a high discharge head is required, but the water level is below the suction limit of the pump, jet pumps are often used to pump water into the suction end of a conventional centrifugal pump, which then pumps to the required head in the normal way. In this manner, all moving parts are above ground and easily accessible and only the jet pump is below ground.

Another advantage of liquid jet pumps is their ability to handle liquids containing solids. As long as the solids are small enough to pass through the narrowest throat section of the pump they will not interfere with operation. For this reason these pumps are widely used for pumping slurries, sandy water and semi-solids.

Apart from their main use in pumping water from wells and in mine pumping operations, they have many other applications. When used to prime centrifugal pumps the jet pump suction line is connected to the centrifugal pump casing, in which it pulls a vacuum which sucks up the liquid to be pumped. They can be used for ordinary hot water circulating duty, as boosters on the suction end of conventional pumps, for handling air and gases, or for pulling a high vacuum where steam is not available. When made of glass or other corrosion resistant material they can handle corrosive liquids.

Though liquid jet pumps usually have lower efficiencies compared to centrifugal pumps, the power needed to drive them is often offset by their simplicity, reliability, and low maintenance.

The method of constructing performance curves, shown on the following pages, is based on the detailed treatment by Prof. R. G. Folsom, *Predicting Liquid Jet Pump Performance*, Proceedings of the National Conference on Industrial Hydraulics, 1948, Vol. 11. Information on the theory of the liquid jet pump is contained in *The Water Jet Pump*, by J. E. Gosline and M. P. O'Brien, Univ. of Calif. Pub. in Engr., Vol. 3, No. 3, 1934, pp. 167–190.

This method does not involve design features but uses data obtained from simple running tests. Once the curves have been built up they can be used to determine the flow at any other head, the head corresponding to any other flow, and the pump efficiency under each operating condition. The example on the following pages assumes that the drive and pumped liquids are the same.

*Associate Professor of Mechanical Engineering, University of California

To figure performance curves, turn page

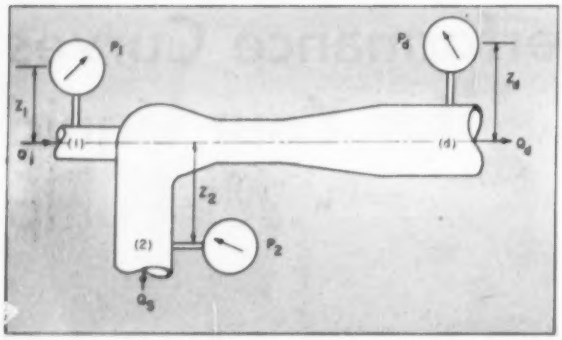


Fig. 3. Pump arrangement for running tests to obtain data from which performance curves can be made

Step-by-Step Way to Construct Curves

In this method jet pump performance is evaluated from the energies of the fluid streams entering and leaving the pump and the flow rates of each fluid stream. Energy is added to the pumped flow at the expense of energy in the drive flow. These energies are obtained by measuring pressures and flow rates in the three fluid streams. Fig. 3 illustrates a typical test set-up.

Pressure measurement positions are usually located as close to the pump as possible in the straight portions of connecting pipe so that they are in regions of the fluid stream uninfluenced by bends or other fittings.

Total mechanical energy, or head, at any point in a fluid stream is,

$$h = \frac{p}{w} + z + \frac{V^2}{2g}$$

where: h = Head — ft of fluid
p = Pressure — lb per sq ft
w = Unit weight of fluid — lb per cu ft
z = Elevation difference between the measured pressure and the center line of the pump — ft (Note that elevations above the center line are positive. Elevations below the center line are negative.)
V = Average velocity of the fluid — ft per sec
g = 32.2 ft per sec per sec

Flow rates are obtained by measurement with any reliable flow meter. Only two of the three flow rates need be measured since the third will result from the combination of the other two. Velocity at the pressure tap location can be evaluated from the flow rate and the cross-sectional area of the pipe.

From the test there results, with the same driving liquid and pumped liquid:

Q_s = Pumped flow rate — gal per min
Q_j = Drive flow rate — gal per min
$Q_d = Q_s + Q_j$ = Discharge flow rate — cu ft per sec

$h_1 = \frac{p_1}{w} + z_1 + \frac{V_1^2}{2g}$ = Input energy per lb of fluid — ft

$h_2 = \frac{p_2}{w} + z_2 + \frac{V_2^2}{2g}$ = Suction energy per lb of fluid — ft

$h_d = \frac{p_d}{w} + z_d + \frac{V_d^2}{2g}$ = Discharge energy per lb of fluid — ft

Only five or six different combinations of flow rates Q_j and Q_s are necessary to establish the basic characteristic curve. This is a plot of the head ratio, H, as a function of the flow ratio, M, where,

$$M = \frac{Q_s}{Q_j} \quad \text{(Eq. 1)} \qquad H = \frac{h_d - h_2}{h_1 - h_d} \quad \text{(Eq. 2)}$$

Fig. 4 illustrates this relationship for a particular jet jump.

The efficiency of the jet pump is defined as:

$$E = \frac{Q_s}{Q_j}\frac{(h_d - h_2)}{(h_1 - h_d)} \times 100 = MH\,(100) \quad \text{(Eq. 3)}$$

This can also be evaluated from the test results and plotted with the efficiency as a function of the flow ratio (Fig. 4).

From these two characteristic curves the performance of the jet pump may be evaluated for any operating condition. This computation for a single operating point is quite involved. However, the complete performance curves to cover a wide range of operating conditions can be constructed with relative ease. The resulting performance curves are shown in Fig. 7. Lines of constant $h_1 - h_2$, $h_1 - h_d$, $h_d - h_2$, and efficiency are shown as functions of Q_s and Q_j. From these the operation at any condition can be easily determined.

The necessary equations for the construction of the performance curves from the characteristic curves are:

$$h_1 - h_2 = Q_s^2\left(\frac{C_1}{M^2} + C_2\right) \quad \text{(Eq. 4)} \qquad h_d - h_2 = \frac{H}{1+H}(h_1 - h_2) \quad \text{(Eq. 5)}$$

$$h_1 - h_d = \frac{h_1 - h_2}{1+H} = (h_1 - h_2) - (h_d - h_2) \quad \text{(Eq. 6)}$$

The procedure to follow can best be explained by an example. From the test of the pump with characteristics shown in Figs. 4 and 7 the following test data for one run were obtained.

SAMPLE TEST DATA—WITH WATER

Run	Pressures (psi)			Elevations (ft)			Flow Rates (gal per min)	
	p_1	p_2	p_3	z_1	z_2	z_3	Q_j	Q_s
3	45.3	4.0	17.2	3.0	−2.0	3.0	18.8	11.8

The test arrangement was similar to that diagrammed in Fig. 3. Gage connecting pipes were filled with water to centerline of gages. Pipe sizes were

	Nominal Diam. in.	Actual Internal Diam. in.	Area (sq ft)
Suction line	1½	1.61	0.041
Drive line	1	1.05	0.0063
Discharge line	1¼	1.38	0.0104

These data can be reduced to the desired heads. For example:

$$h_1 = \frac{p_1}{w} + z_1 + \frac{V_1^2}{2g}$$

p_1 = 45.3 lb per sq in. (from the data) = 45.3 (144) = 6520 lb per sq ft

w (for water) = 62.4 lb per cu ft $\qquad \frac{p_1}{w} = \frac{6520}{62.4} = 104.5$ ft

z_1 = 3.0 ft (from the data) $\qquad V_j = \frac{Q_j}{A_j}$ where A_j = Area of the drive line.

Q_j = 18.8 gals per min (from the data) = $\frac{18.8}{450} = 0.0418$ cu ft per sec

$V_1 = \frac{0.0418}{0.0063} = 6.6$ ft per sec and $\frac{V_1^2}{2g} = \frac{(6.6)^2}{(2)(32.2)} = 0.7$ ft

Then $h_1 = 104.5 + 3.0 + 0.7 = 108.2$ ft. h_2 and h_d can be computed in a similar manner.

For this pump six runs were made over a range of flow rates. The data reduce to the following for the six test points:

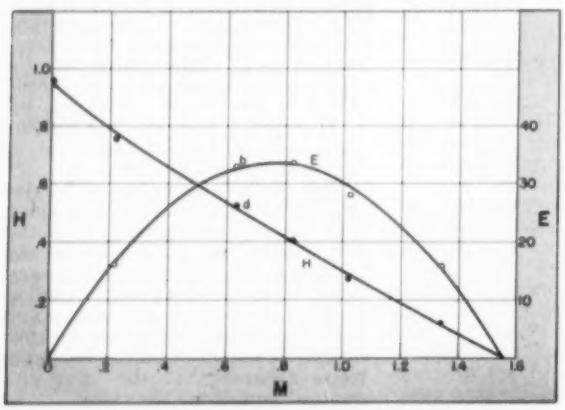


Fig. 4. Characteristic curves obtained from running test of liquid jet pump. From these results complete performance curves for the pump can be prepared

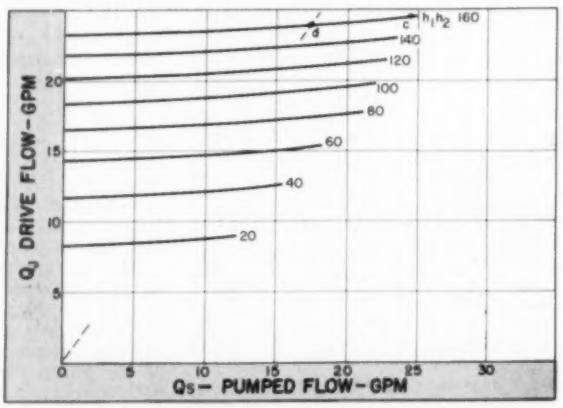


Fig. 5. Curves showing difference between the input energy and suction energy of the pump as a function of drive flow and pumped flow in gal per min

Test Results

Run	Q_s gal per min	Q_j gal per min	h_1 ft	h_2 ft	h_d ft
1	0	22.6	160.5	12.5	84.5
2	4.5	20.9	138.9	10.7	65.8
3	11.8	18.8	108.2	9.3	43.4
4	14.6	17.7	94.8	8.6	33.4
5	17.2	16.8	82.3	8.1	24.1
6	20.0	15.0	62.7	7.0	12.9

Run 3 will be taken as an example to determine a point on the MH curve and a point on the EH curve.

1. $M = \frac{Q_s}{Q_j} = \frac{11.8}{18.8} = 0.630$ (Eq. 1)
2. $h_1 - h_d = 108.2 - 43.4 = 64.8$ ft
3. $h_d - h_2 = 43.4 - 9.3 = 34.1$ ft
4. $H = \frac{h_d - h_2}{h_1 - h_d} = \frac{34.1}{64.8} = 0.527$ (Eq. 2)
5. Plot this point on the HM curve. (Labeled (a) on Fig. 3.)
6. $E = MH = (0.630)(0.527) \times (100) = 33.1\%$ (Eq. 3)
7. Plot this point on the EM curve. (Labeled (b) on Fig. 4.)
8. Repeat operations 1 thru 7 for the other runs. The curves may then be drawn thru the plotted points to give the characteristic curves.
9. For two test runs obtain $h_1 - h_2$, M, and Q_s to get C_1 and C_2 in Eq. 4.

From Run 2 $h_1 - h_2 = 138.9 - 10.7 = 128.2$ and $M = \frac{Q_s}{Q_j} = \frac{4.5}{20.9} = .215$

In Eq. 4 $h_1 - h_2 = Q_s^2\left(\frac{C_1}{M^2} + C_2\right)$ $\quad 128.2 = (4.5)^2\left(\frac{C_1}{(0.215)^2} + C_2\right)$

From Run 5, $h_1 - h_2 = 82.3 - 8.1 = 74.2$ ft and $M = \frac{17.2}{16.8} = 1.020$

In Eq. 4, $74.2 = (17.2)^2\left(\frac{C_1}{(1.020)^2} + C_2\right)$

These two equations when solved simultaneously give

$C_1 = 0.294$ and $C_2 = -0.031$

The resulting equation which relates $h_1 - h_2$, M, and Q_s is

$$h_1 - h_2 = Q_s^2\left(\frac{0.294}{M^2} - 0.031\right)$$

The performance curves of Fig. 6 may now be evaluated from this equation and the characteristic curves.

10. Select any value of $h_1 - h_2$, for example $h_1 - h_2 = 160$ ft.
11. Select any value of M, for example M = 1.00
12. Compute Q_s from the final equation of Step 9.

$160 = Q_s^2\left(\frac{0.294}{(1.00)^2} - 0.031\right)$ $\quad Q_s = 24.6$ gal per min

13. Compute Q_j from the value of Q_s from Step 12 and from the value of M from Step 11, in Eq. 1. $\quad 1.0 = \frac{24.6}{Q_j}$ $\quad Q_j = 24.6$ gal per min
14. This establishes a point on the performance curve of $h_1 - h_2$ on the Q_s Q_j coordinates. Point (c) on Fig. 5.
15. Repeat Steps 11 thru 13 for other values of M to complete the curve with the constant value of $h_1 - h_2$ of Step 10.
16. Select other values of $h_1 - h_2$ and repeat Steps 10 to 15 to determine curves of other constant values of $h_1 - h_2$. Curves shown in Fig. 5.
17. Select any value of $h_d - h_2$, for example $h_d - h_2 = 50$ ft.
18. Select one value of $h_1 - h_2$ already used, example $h_1 - h_2 = 160$ ft.
19. From Eq. 5 compute H. $\quad 50 = \frac{H}{1+H}(160)$ $\quad H = .454$
20. Obtain M for this value of H from the curve of Fig. 3. $\quad M = 0.725$
21. This value of M is on a straight line from origin of the Q_s Q_j coordinates. Locate this line from an easily computed point. Select $Q_j = 20$ gal per min

Then from Eq. 1, $\frac{Q_s}{20} = 0.725$ $\quad Q_s = 14.5$ gal per min

Pass a line thru this point and the origin on the coordinate system. The intersection of this line and the $h_1 - h_2$ value of Step 18 locates a point on the line of constant $h_d - h_2$ selected in Step 17. Point (d) on Fig. 5.

22. Repeat Steps 18 thru 21 for other values of $h_1 - h_2$ with the value of $h_d - h_2$ of Step 17. This locates the curve of constant $h_d - h_2$.
23. Select other values of $h_d - h_2$ and repeat Steps 17 thru 22. Fig. 6 contains the curves of Fig. 5 with the addition of curves of $h_d - h_2$.
24. Intersections of curves of $h_1 - h_2$ and $h_d - h_2$ fix points of $h_1 - h_d$ since

$h_1 - h_d = (h_1 - h_2) - (h_d - h_2)$ (Eq. 6)

Select a constant value of $h_1 - h_d = 60$ ft.

25. At $h_1 - h_2 = 80$ and $h_d - h_2 = 20$, $h_1 - h_d = 80 - 20 = 60$ ft
This fixes a point on line of constant $h_1 - h_d = 60$ ft. Point (e) on Fig. 6.
26. Identify other points of intersection of the $h_1 - h_2$ and $h_1 - h_d$ curves that will result in this same value of $h_1 - h_d$ to construct the curve of constant $h_1 - h_d$. Fig. 7 contains curves of Fig. 6 with $(h_1 - h_d)$ curves added.
27. Repeat Steps 24 thru 26 for other curves of constant $h_1 - h_d$.
28. Each value of $M = \frac{Q_s}{Q_j}$ is also a value of constant efficiency from Fig. 4.

Select a value of efficiency, for example 30 per cent.

29. Obtain the value of M from Fig. 3. M = 0.51.
30. Since $M = \frac{Q_s}{Q_j}$ is a straight line from the origin on the Q_s Q_j coordinate system, and one value of the efficiency corresponds to this M value, the efficiency line will correspond with this M line. Select any value of Q_j such as 10 gal per min.
31. Compute Q_s. $\quad 0.51 = \frac{Q_s}{10}$ $\quad Q_s = 5.1$ gal per min
32. Place a straight line thru the origin and the point determined by Q_j and Q_s from Steps 30 and 31. Point (f) on Fig. 7. This is the line of constant efficiency, in the example the line of E = 30 per cent. Note that for all but the peak value of the efficiency curve of Fig. 4 two lines at different M values will result for each efficiency.

The performance curves are now complete. They can be used to determine a performance point for any desired operating condition. For example, it is desired to pump 15 gal per min from a head at the suction side of the pump of 10 ft to a discharge head of 50 ft. $\quad Q_s = 15$ gal per min

$h_2 = 10$ ft $\quad h_d = 50$ ft $\quad h_d - h_2 = 40$ ft

From the performance curves of Fig. 7 these values of Q_s and $h_d - h_2$ locate one point on the chart, labeled (g). At this point,

$Q_j = 21.3$ gal per min

$h_1 - h_d = 87$ ft $\quad$ or $h_1 = 87 + h_d = 87 + 50 = 137$ ft

Thus the necessary drive quantity is 21.3 gal per min at a head of 137 ft at the pump. The pump efficiency of 33 per cent is also determined from this point. Pressures may be determined from the heads by the same equation used in the reduction of the sample test data.

The above analysis pertains to the jet pump alone. When pressures are to be determined in the piping system at locations other than those used for the test then the pipe line losses must be evaluated by standard methods to compute these pressures from h_1, h_2, and h_d, at the pump.

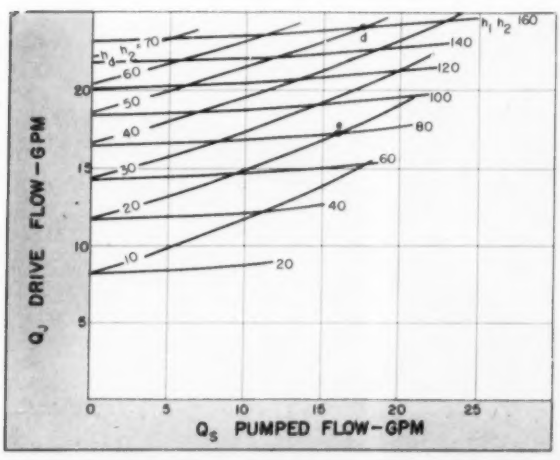


Fig. 6. Curves of difference between discharge energy and suction energy and between input and suction energies as functions of drive and pump flows

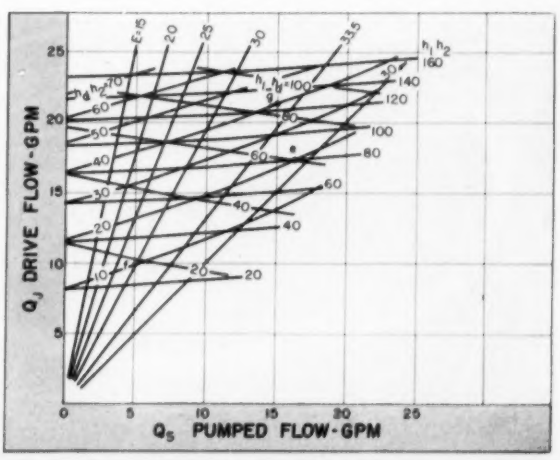
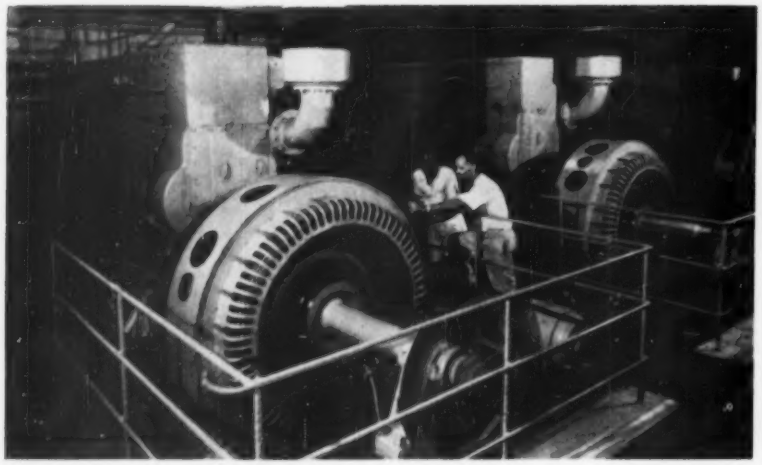


Fig. 7. Complete performance curves for liquid jet pump prepared from simple running test data. These curves give the performance under any condition



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Power Engineering's NEWS REEL

1 Monrovia Port Management Co., Ltd., in Liberia, West Africa, has purchased a fourth Superior diesel for its Krutown power plant. The 1765-bhp, 600-rpm unit will boost plant capacity to 2450 kw

2 G.E.'s jet engine plant at Evendale recently shipped its 10,000th engine to the Air Force. Their Lynn, Mass., plant is rapidly nearing that score

3 Stator frame of McNary Dam's third of twelve G.E.-supplied generators is shown on the 60-ft vertical boring mill at the Schenectady plant. When installed, it will up McNary's power 73,684 kva

4 Now it's Boston baked concrete! Grid of one- and two-in. wrought iron pipe is being set in the access ramps of Boston's new $25-million aerial highway to circulate hot water mixed with anti-freeze and keep 161,000 sq ft free of ice, snow

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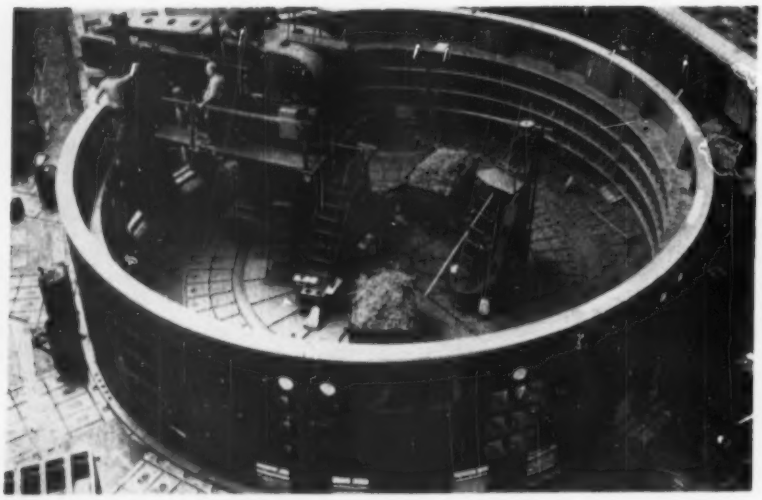

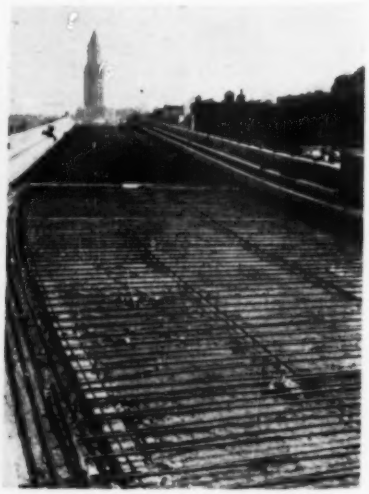

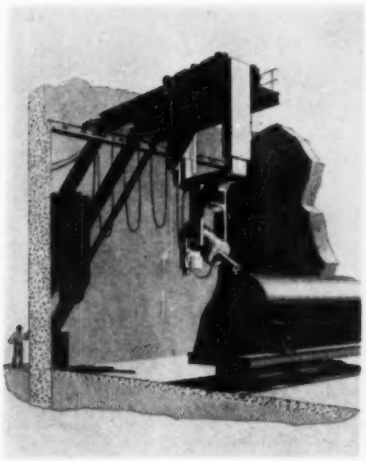

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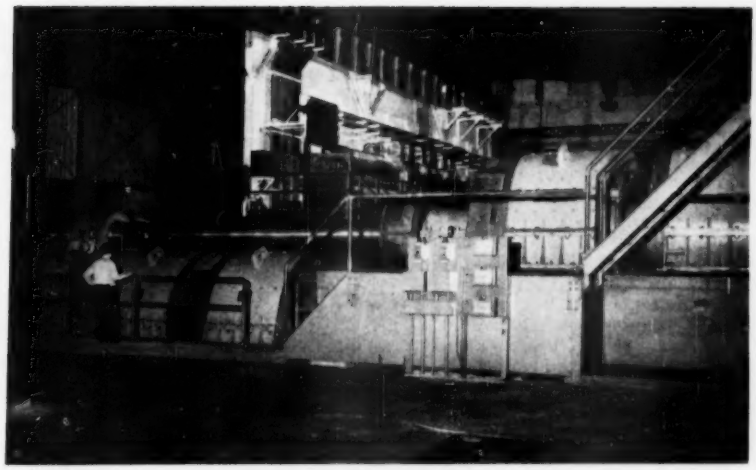

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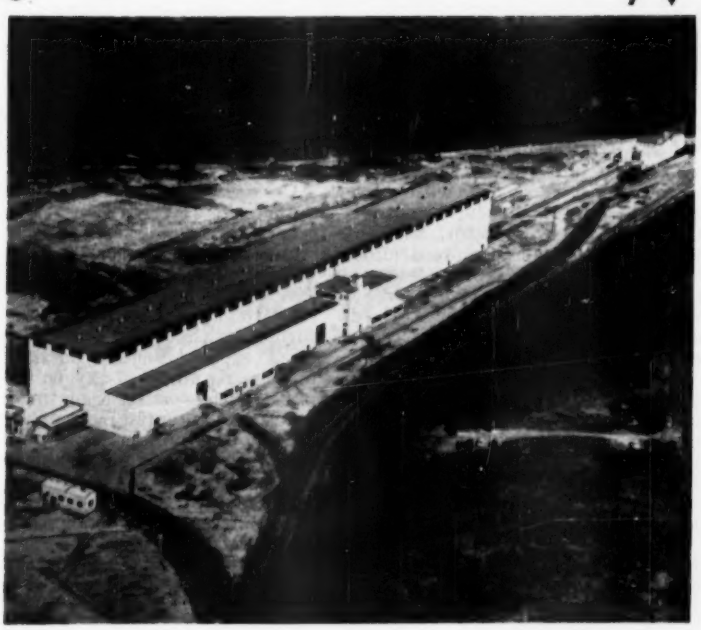
Two-million-volt Van de Graaff X-ray generator is being used by Foster Wheeler in their new Mountaintop, Pa., plant to check welds. It is located 550 ft from main plant within 4-ft concrete walls 5

This all-electric drive replaced the 41-year-old steam engine which broke records at Jones & Laughlin Steel since 1912. Now blooming mill is driven by four dc motors and a 9,000-hp m-g set 6

Aerial view of Foster Wheeler's new Mountaintop, Pa., plant. Main Bay is 800 ft long, 75 ft high. X-ray building is at extreme upper right corner 7

Aerial lift bridge at Duluth, Minn., is raised by battery power in 55 seconds, 30 times per day. An m-g set charges 800-amp-hr unit at constant rate 8

Person Station, Public Service Co. of New Mexico, where a B & W 305,000-lb-per-hr boiler will go up soon as part of a $22-million expansion program 9



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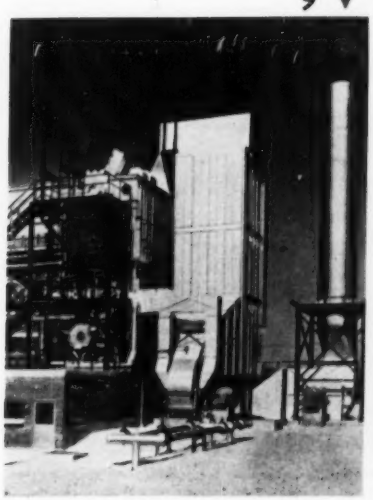
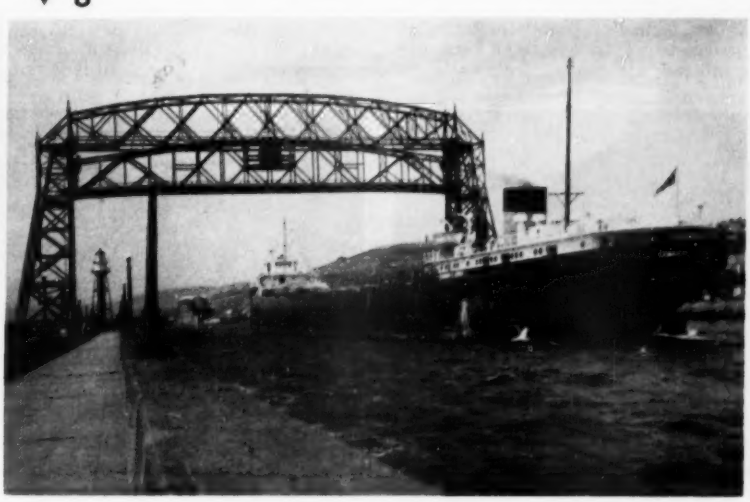




F. L. LaQue Tells What to do About

The Water Side Deterioration of Diesel Cylinders

Ordinary corrosion is readily controllable by chromates . . . Crevice cavitation is more difficult to check . . . Cavitation, erosion or dynamic pitting recently identified and reproduced in the laboratory is less frequent but often extremely rapid . . . High chromate concentrations, material selection, vibration dampening and air injection have all been successful

Fig. 1. This is the most common location of cavitation erosion damage on a diesel cylinder liner

ORDINARILY, corrosion on the water side of diesel cylinders does not present much of a problem. Use of water of good quality with a low content of dissolved solids, the addition of a good inhibitor, such as sodium chromate or a combination of nitrate, nitrite and borate, and the adjustment of the pH to around 8.5 with caustic soda will serve to restrain corrosion so that it is not a major factor in cylinder life.

A chromate content of 500 ppm is usually adequate. When salt water is used, control of corrosion will require much higher chromate concentration and it is preferable to use recirculated fresh water for cooling with an auxiliary heat exchanger to cool the fresh water with salt water.

When the system includes combinations of iron and aluminum it is desirable to hold the pH to lower levels — between 7 and 8. There is also some preference for the nitrite-nitrate-borate inhibitor where aluminum is involved.

Two forms of highly aggravated corrosion of cylinders have been encountered sufficiently frequently to present special problems which cannot be taken care of by the conventional practices just mentioned.

Crevice Corrosion: — One of these is the severe attack that sometimes occurs in crevices such as are formed under ring gaskets used to seal the water passages. The mechanism of this attack involves an electrolytic corrosion cell set up between the iron surfaces within the crevices and the freely exposed surfaces outside. The more ready access of oxygen to these outer surfaces causes them to develop an electric potential more noble than that of the iron in the crevices to which the supply of oxygen is restricted.

Current that flows as a result of this difference in potential causes accelerated corrosion of the iron within the crevice. Since there is little or no circulation of water within such crevices, it is very difficult to get corrosion inhibitors to the points where they are needed. Further, since the inhibitors commonly used are of the passivating type and increase the nobility of the outer surfaces that they do reach, it is not unusual for corrosion in crevices to be aggravated rather than reduced by the presence of such inhibitors in cooling water.

Under these circumstances, therefore, the most effective remedy is likely to be the application of a coating so as to seal the crevices and protect the surfaces within. Compounds for this purpose must be able to survive exposure to the hot water. They should also have good adherence and be heavy enough not to float away. Thiokol based sealing compounds have been used satisfactorily for this purpose. They do, however, require renewal periodically at intervals likely to be determined by occasions when the liners may be removed for other reasons.

Galvanic Action: — Occasionally there have been instances of accelerated corrosion of cast iron as a result of galvanic corrosion induced by contact of the iron with copper gaskets. This difficulty is avoided readily by the presence of the passivating inhibitors, such as chromates, as previously mentioned. These serve to eliminate the galvanic action by

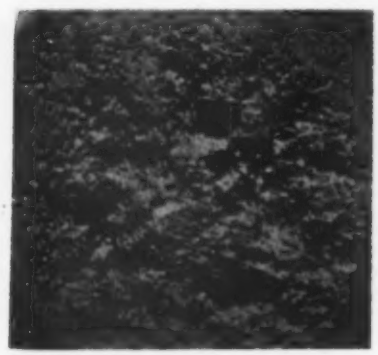


Fig. 2. A case of severe cavitation on the water side of a diesel cylinder. Compare with Fig. 3

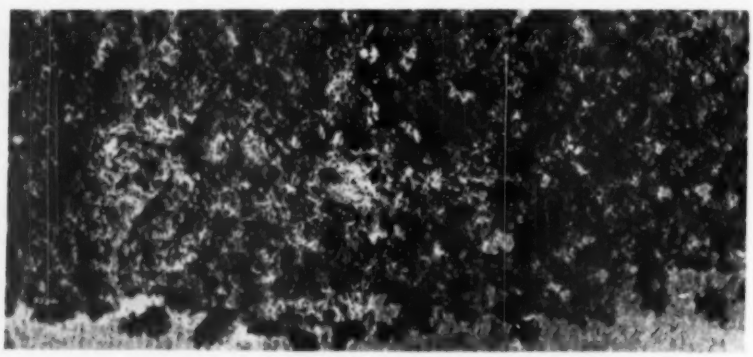


Fig. 3. Cavitation erosion on cast iron reproduced in the laboratory by an accelerated vibratory test. The similarity of this and the engine liner specimen in Fig. 2 indicates that vibration is a significant factor

passivating the iron so that its potential approaches that of the copper gaskets.

Cavitation Erosion: — Probably the most severe and most spectacular damage suffered by diesel cylinder liners is that illustrated in Figs. 1 and 2. This has been attributed to effects of vibration at a high enough frequency and with sufficient amplitude to cause cavitation erosion to occur.[1]

It has been known for some time that severe attacks of cast iron and other metals can be made to occur simply by causing them to vibrate in contact with ordinary water. In fact, a standard method of studying the resistance of metals to cavitation erosion is based on this principle.[2] In this test, a specimen is attached to the lower end of a nickel tube which is caused to vibrate longitudinally in tune with a high frequency magnetic field operating at the natural frequency of the assembled specimen and its carrier.

Fig. 3 shows the attack on a specimen of cast iron subjected to vibratory cavitation erosion in this way. The action is so severe that over 100 mg of iron were removed by erosion by the water in only 90 min. The similarity of the appearances of the eroded specimen in Fig. 3 and the eroded liner in Fig. 2 support the view that the mechanism of attack (vibration) could quite well have been the same in both cases.

When encountered on diesel cylinders, cavitation erosion is characterized by the following features:

1. The extent of attack is beyond anything that might be expected to result from ordinary corrosion by even the most aggressive waters. The rate of penetration may be as great as 3 in. per yr.

2. The attacked surfaces present a characteristic honeycomb appearance with the eroded craters, or canyons, being free from corrosion products and having an irregular outline with walls that are very steep and are bounded by surfaces that show little or no attack.

3. The most severely eroded areas are located in the quadrants 90 deg from the line of the crankshaft. The greatest attack occurs on the side that is slapped by the piston on the power stroke with somewhat lesser attack on the opposite quadrant. There are occasionally faint traces of the same kind of attack in the other two quadrants. Erosion usually starts towards the bottom of a liner and progresses upwards gradually. There have been some instances where erosion of liners seemed to be associated with the location of the water passages. Relocation of these, to avoid impingement of water at high velocity, has been helpful. However, such more usual effects of water flow have been incidental to the more severe destruction such as shown in Fig. 1 which is believed to be the result of vibratory cavitation erosion.

4. Cavitation erosion is not confined to any particular make or type of engine. All engines of the same kind operating on the same water are not equally subject to damage. In fact, some cylinders in an engine may suffer severe attack while others remain unaffected.

There are three principal ways of dealing with this problem:

1. Get rid of the high frequency vibrations.

2. Treat the water with appropriate inhibitors.

3. Use a liner material more resistant to cavitation erosion.

Reducing Vibration: — In some cases the elimination of destructive vibration may require some changes in engine design so as to support the liners in such a way as to dampen out the vibration. This may also be reduced by providing a better fit of the liners in the block, e.g. a clearance of not more than 0.0015 inch per inch of liner diameter. This clearance should be the same at both the top and bottom of the liners.

When liners are installed care should be taken to position them carefully so that they will not be located off center and so that there will be uniform clearance all around. Resilient compounds for sealing the liners in place such as mentioned previously in connection with avoiding crevice corrosion will also be helpful.

Water Treatment: — The concentration of chromate or other inhibitors required to control cavitation erosion will be much greater than is used to take care of ordinary corrosion as described previously. The chromate content should be at least 2,000 ppm and may be even higher, e.g. 4,000 ppm in some cases. The pH level should be held at 8.5 to 9.5. The use of inhibitors should begin immediately when an engine is placed in service; it is easier to keep the attack from starting than to stop it after it is well under way.

Liner Materials: — Other things being equal, the harder the liner material, the greater will be its resistance to cavitation erosion and the easier it will be to prevent this kind of attack by adding inhibitors to the water. Thus, hardened alloy cast iron liners have this advantage.[3] Even further improvements have been observed in practice with liners made of the austenitic cast iron Ni-Resist[3] which,[1] in diesel truck service, have shown relatively little cavitation erosion on the water side after 90,000 mi where ordinary cast iron liners suffered considerable water side deterioration, as well as inner cylinder wear, in 35,000 mi. Some Ni-Resist liners have been kept in this service for 250,000 mi before requiring reboring and honing and the life of others has been extended to nearly a half million miles by such reconditioning. Reboring and honing is considered standard operating procedure among many operators.

Miscellaneous Steps: — Viewing this peculiar deterioration as a form of cavitation erosion, it might be expected that steps found to be effective in reducing these effects in other instances might be useful. These would include:

a. Keeping the water temperature as high as practical so as to reduce the violence of the collapse of the cavitation vapor bubbles.

b. Operating with as high a water pressure as practical.

c. Introducing air bubbles to serve as cushions against the hammering effect of the collapse of the vapor bubbles. This is common practice in hydraulic turbines and might be beneficial in this case as well.

d. Protective coatings might be tried, though experience to date has not been very encouraging in overcoming severe vibratory effects. This is because of the difficulty in getting coatings to adhere under the severe conditions encountered in the areas subjected to the cavitation erosion action.

While the remedies proposed have been reasonably effective in most cases, it seems likely that further research will be useful in eliminating the difficulty at its source. This will involve studies of vibration under different conditions of operation and the relation of this to the damage that is observed.

ABOUT THE AUTHOR

F. L. LaQue is internationally known for his work in the field of corrosion. He graduated in Chemical and Metallurgical engineering from Queen's University, Canada, in 1927. Since that time he has been associated with the International Nickel Co. Inc. in the Development & Research Division. He has served as Assistant Director of Technical Service and at present is in charge of the Corrosion Engineering Section. He is active in many ASTM Committees, is past president of the NACE, recipient of the F. N. Speller Award in 1949 and delivered the Edgar Marburg Memorial Lecture in 1951.

[1] F. N. Speller and F. L. LaQue, "Water Side Deterioration of Diesel Engine Cylinder Liners," *Corrosion*, Vol. 6, No. 7, 1950, p. 209.

[2] S. L. Kerr, "Determination of the Relative Resistance to Cavitation-Erosion by the Vibratory Method," *Trans. Am. Soc. Mech. Eng.*, Vol. 59, No. 5, 1937.

[3] Wm. J. Rheingans, "Accelerated Cavitation Research," *Trans. Am. Soc. Mech. Eng.*, Vol. 72, p. 705, July 1950. Ni-Resist is a registered trade mark.

There is a Fan for Every Need

By JOHN F. TOBIN *

Before choosing a fan you must know the characteristics called for by the installation. At this point you discover that each fan type did not just happen; it was developed to fill a need

A FAN IS A ROTARY bladed-wheel machine capable of transferring mechanical energy to kinetic and potential energy in air or gases. In order to perform useful work, it is fitted with a stationary ring, cylinder or housing to permit control of the point of air entry and exit. The rotating bladed wheel will be able to impart radial or axial velocity to the air depending upon the angularity of the blades with respect to its centerline.

Centrifugal Fans

Centrifugal fan wheel blades are set parallel to its shaft centerline so that the air is thrown centrifugally outwards at right angles to the shaft. A stationary scroll shaped housing surrounds the wheel with one or two circular inlets centered on the shaft and an outlet at end of scroll at right angles to the shaft to which duct work can fasten as well as to the inlet. Velocity or kinetic energy is transformed to the static or potential energy necessary to overcome resistance of the duct system, partly in the wheel and partly in the housing, the relative conversion varying with the several blade types.

Centrifugal fans are made in three basic blade shapes with respect to the wheel diameter when viewing the wheel from the drive end:

A — Straight radial blades
B — Forward curved blades
C — Backward curved blades

When the present major fan manufacturers started to make fans some three-fourths of a century ago, they made straight radial blade wheels for the original service was removing wood chips, exhausting cotton gins or blowing forge fires. This type is still preferred today for handling hot and cold air containing abrasive or sticky materials and the performance efficiency is good for low volume high pressure requirements of all types. However, the radial blade fan requires a deep blade for good efficiency, resulting in large housing sizes with respect to the inlet and outlet areas. The shaft speed is low, requiring belt drive except in the small sizes or for high temperature or high pressure applications.

Around the turn of the century fans became more generally applied to drying, process work, mechanical draft, ventilation and similar applications requiring smaller and more efficient fans to handle large quantities of air at moderate pressures. The forward curved multi-blade fan was introduced towards the end of the first decade. It was very well accepted because its reduced over-all size, large inlet and outlet connections, high efficiency, and quiet operation were greatly needed. Naturally the basic type was widely imitated, although the patents compelled non-essential variations that sometimes were detrimental to good operation. The shaft speed is low, requiring belt drive except in small sizes or for high temperature or high pressure service.

Direct Drives

Near the end of the second decade of this century, fans with backward curved blades were developed primarily to operate at higher shaft speeds to permit more economical direct drive from standard speed electric motors. Where noise was not important, as in manufacturing and power plants, this high speed type of fan quickly became very popular. Refinements in design, streamlining and careful attention to manufacturing processes have raised the efficiency and reduced the noise level to a point where it is acceptable even for most low pressure ventilation systems.

In the third decade a modified steel plate characteristic fan was introduced, having the wheel blades radial at the tip only and forwardly inclined

*American Blower Corp.

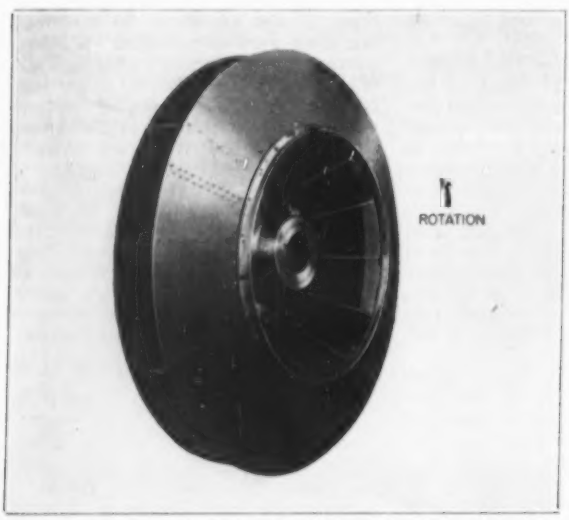


Fig. 1. Straight radial wheel for low speeds, sticky or abrasive materials

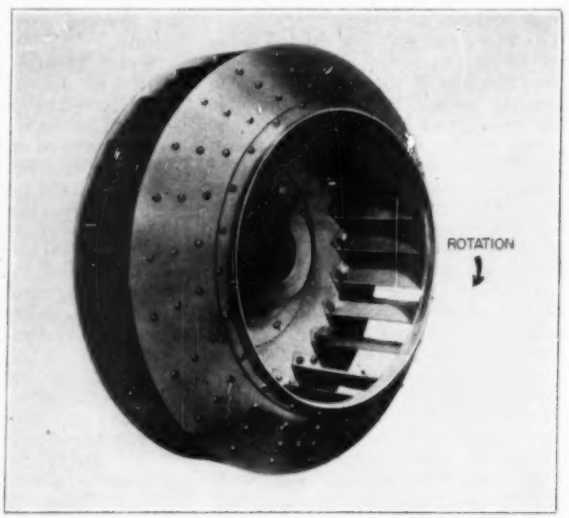


Fig. 2. Radial tipped forward curved blades are most used for induced draft

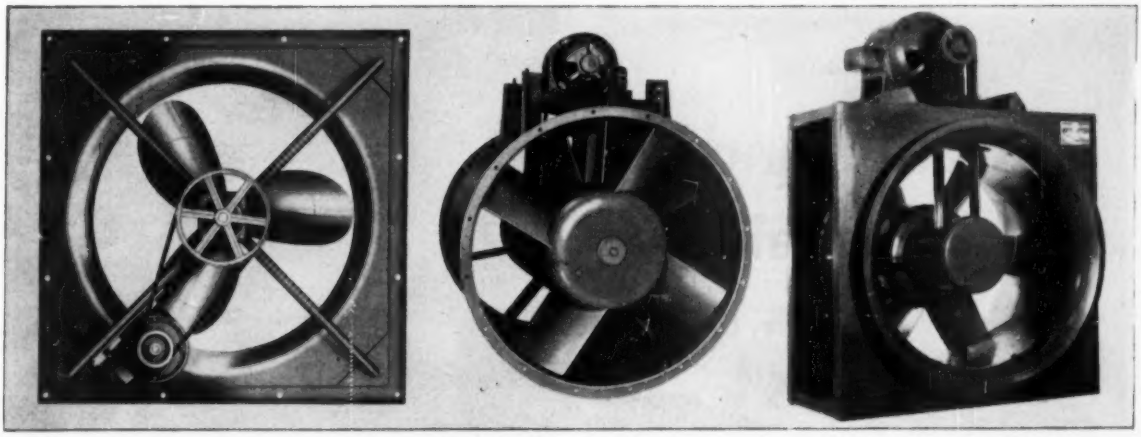


Fig. 3. From left to right are the propeller, vaneaxial and tubeaxial type fans. The latter two are duct-connected and will develop a higher discharge head

at the heel, in order to direct connect economically to standard speed electric motors. This is a medium speed fan intended primarily for induced draft service, and is seldom used for general fan service in industry or ventilation.

Centrifugal fans ** are classified by the National Association of Fan Manufacturers as to (1) arrangement of drive, (2) designation of direction of rotation and discharge, (3) designation of position of inlet boxes, (4) motor position, belt or chain drive and (5) operating limits for Class 1, 2, 3 and 4 fans as shown in National Association of Fan Manufacturers Bulletin No. 110, second edition, copyright 1952.

Axial Flow Fans

Propeller or disk fans have been used for low pressure ventilation systems for well over half a century. Rather recently tubeaxial and vaneaxial fans became available for higher pressure service.

Propeller fan wheel blades are set at an angle to the shaft centerline so that the air is pushed or propelled along the shaft similar to the action of a ship or airplane propeller. The wheel operates in a hole usually streamlined in a mounting plate to which the shaft, bearings, drive and motor are attached to make a unit assembly. The complete fan is usually mounted in a wall or bulkhead to move air from one space to another, without extensive duct work or resistance. Automatic or power-operated shutters, safety guards and roof mounted penthouses or ventilators are normal accessories used with this type fan.

Tubeaxial fans are similar in basic principle to propeller fans, but are provided with inlet and outlet flanges for duct connection. The wheels have large streamlined hubs so the blade space area provides the correct relation between flow and pressure over the recommended rating range. The blades are usually streamlined and shaped in accordance with aerodynamic principles.

Vaneaxial fans are similar to tubeaxial fans except with the addition of stationary guide vanes either before or after the wheel to recover some of the velocity energy in the air leaving the wheel and to deliver the air more nearly axially at the discharge flange. These vanes function somewhat the same as does the housing on a centrifugal fan.

Vaneaxial Most Efficient

This type of fan is the most efficient and quietest of the propeller classification. It should be furnished with inlet and outlet cones when ducts are used on both sides of the fan. Elbows next to the cones should be avoided, but if necessary should be correctly bladed. If vaneaxial fans are used for blowing service with outlet cone and discharge ducts, the open inlet should have a streamlined inlet ring and wire safety guard.

All these fans have a definite place in industrial service and the user-engineer is cautioned against the generalization that one type is usually or always better than any other type.

** A second article, to appear soon, will deal with the selection of the right fan for specific jobs, including performance charts, curves, tables and data on system resistances.

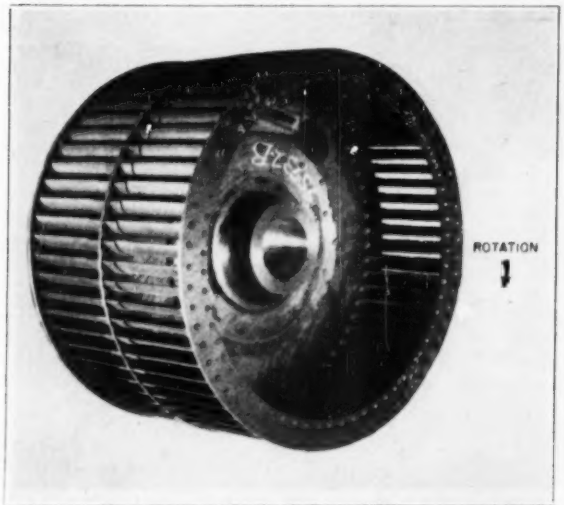


Fig. 4. Forward curved blades are both quiet and efficient at low speeds

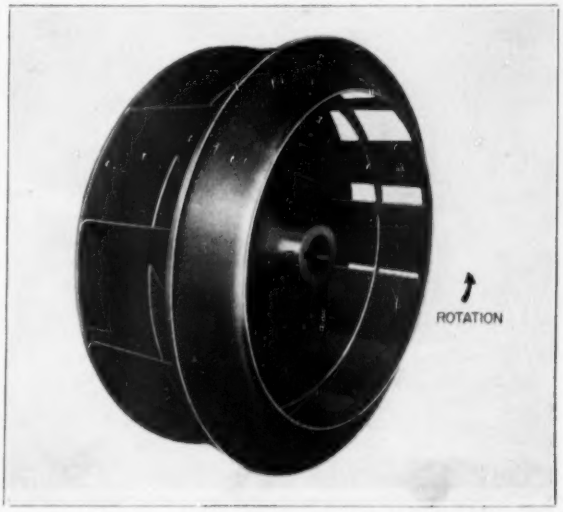


Fig. 5. Backward curved blades were developed for direct-connecting motors

Coal Handling at Danskammer

By C. A. HOYA *

Careful attention to details of conveyor belts and drives, interlocks, liberal use of stainless steel, provision for future units, mark system designed for present and ultimate units at Danskammer Point Steam Station

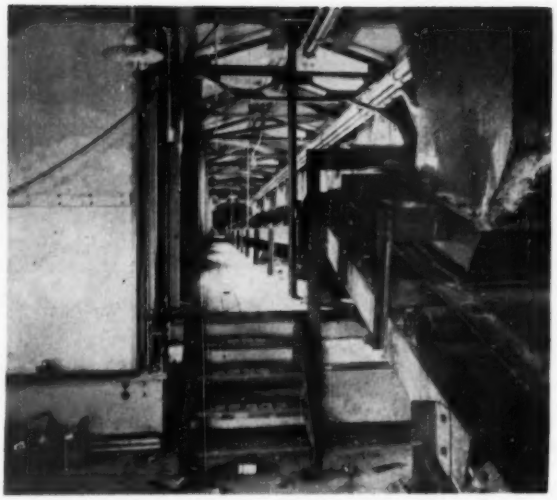


Fig. 1. Horizontal bunker belt conveyor, at right angles to inclined belt delivering coal from crusher house, transports coal to bunkers at Danskammer

TO SATISFY expanding electrical demands of the Poughkeepsie, N. Y., area, Central Hudson Gas and Electric Corp. recently placed in operation its Danskammer Point Steam Station, Fig. 2, located at Danskammer Point on the Hudson.

This station has Unit No. 1, of 60,000 kw, in operation, and Unit No. 2, also of 60,000 kw, under construction. Units No. 3 and 4, scheduled for the future, may have a capacity of 100,000 or 125,000 kw each. This would provide an ultimate scheduled station capacity of 320,000 or 370,000 kw.

The coal-handling equipment installed at present serves Unit No. 1 and will also serve Unit No. 2. This equipment has a capacity of 300 tons of bituminous coal per hour. Coal is received at the site in 50- or 60-ton hopper cars — averaging 54.5 tons per car. The rate of unloading into the twin track hoppers is 5 cars per hour. The tops of the hoppers are equipped with bar grates having 12-in.-square openings; thus, lumps of 12-in. size can enter the system. The coal, of final ¾-in. maximum size, is discharged into the bunkers

* Engineer, Chain Belt Co.

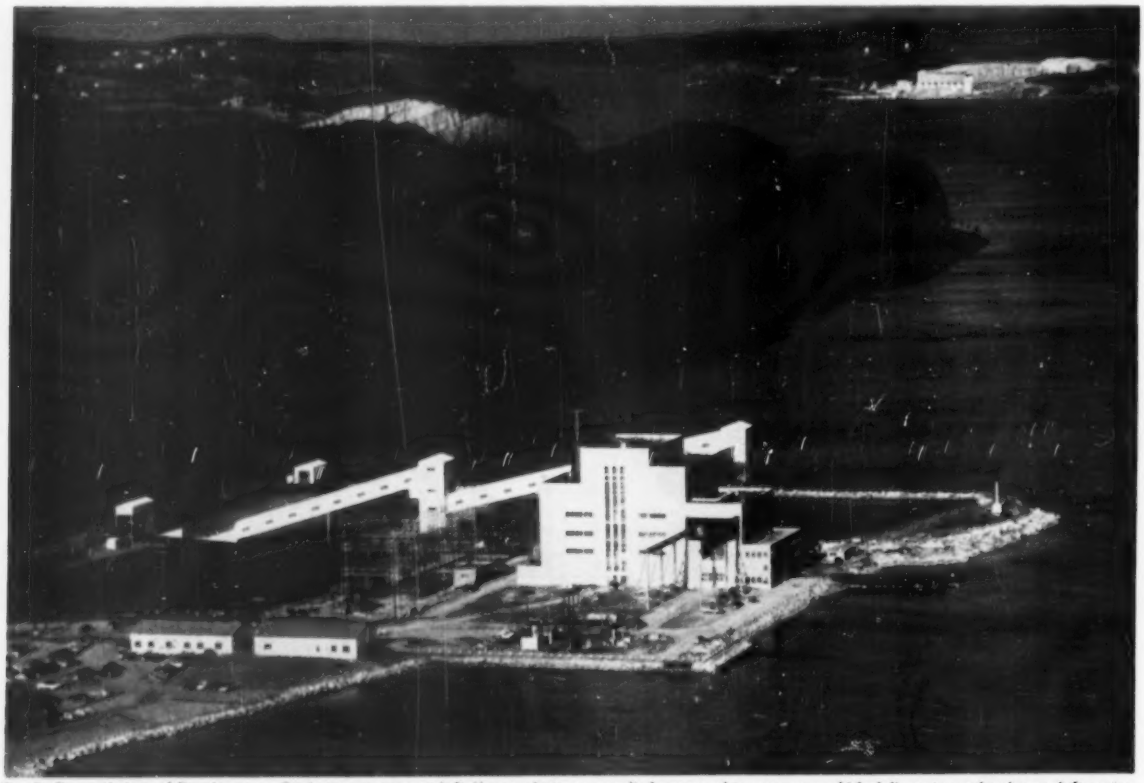


Fig. 2. General view of Danskammer. Coal storage area at left. Hopper bottom cars discharge coal to conveyor, which delivers to crusher house, left center. Crushed coal can be discharged to outside storage or delivered by inclined belt conveyor to junction house, thence by horizontal belt to boiler house bunkers

Fig. 3. Pan feeders under track hoppers discharge through this hopper to collecting belt conveyor

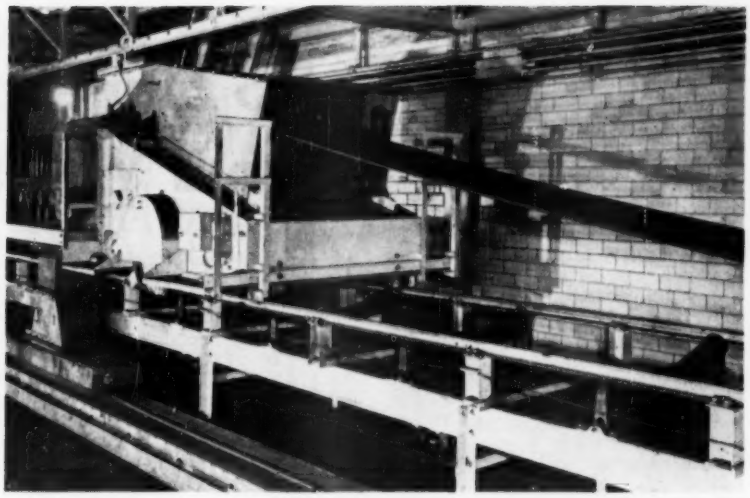


Fig. 4. Motor-driven tripper on horizontal bunker belt conveyor. It has twin side-discharge chutes, flexible sealing covers over coal charging slots, mechanism for operating seals, and special type trolley

or to outside storage. Coal from the outside storage is reclaimed by way of the track hoppers.

The 13-ft-square steel track hoppers are equipped with rack and pinion gates to control the flow of coal onto twin 48-in. inclined leakproof pan feeders of 4½-ft centers, each driven by a 3-hp motor. Each hopper and feeder handles one half of the total capacity. These feeders are arranged in tandem, parallel to the track, and have a common discharge onto a 42-in. inclined collecting belt conveyor, Fig. 3, of 21¼-ft centers, and driven by a 7½-hp motor. This collecting belt is located full-length under both feeders and parallel to them; thus it serves also as a dribble conveyor for the feeders, an arrangement which helps to reduce pit housekeeping to an absolute minimum.

Belt Conveyor to Crusher

This collecting belt discharges onto a 36-in. inclined belt conveyor running to the crusher house, Fig. 2. This belt, of 297-ft centers and driven by a 50-hp motor, is located at 90 deg to the collecting belt, its lower section being in a tunnel and its upper section in an enclosed conveyor gallery. Initial belt tension is maintained by a vertical gravity take-up immediately back of the head pulley. The head shaft is equipped with a ratchet-wheel backstop having a solenoid-actuated pawl. A permanent-magnet head pulley removes any tramp iron in the coal and diverts the iron into a suitable container.

A size 48-S ring type crusher, driven by a 125-hp motor, receives the coal discharged from the foregoing belt, reduces it to a maximum size of ¾ in. and discharges it into a hopper. This hopper has a flop-gate-controlled bifurcated outlet chute. One leg of this chute leads to the yard storage; the other leg discharges onto a gallery-enclosed 36-in. inclined belt conveyor leading to the junction house.

Belt conveyor to junction house, of 286-ft centers and driven by a 40-hp motor, is equipped with a vertical gravity take-up immediately back of the head pulley, and its head shaft is equipped with a ratchet-wheel backstop having a solenoid-actuated pawl. The center of the belt to the crusher and the center of the belt from the crusher are in line.

Bunker Belt Conveyor

The belt from the crusher discharges (in the junction house) onto a 36-in. horizontal bunker belt conveyor located at 90 deg to the belt from the crusher. The bunker belt is parallel to the feeders and collecting belt under the track hoppers; thus, the coal makes two 90-deg horizontal turns in traveling from the track hoppers to the bunkers. Height from top of rails to top of bunker charging slots is 78 ft.

Bunker belt conveyor, Fig. 1, has present centers of 181 ft, part of its length being supported in an enclosed gallery between junction house and boiler house. This conveyor is driven by a 20-hp motor. A vertical gravity take-up is located immediately back of the head pulley. The boiler-house section of this conveyor functions with a motor-propelled tripper (5-hp drive with shoe brake) having twin side-discharge chutes, shown in Fig. 4. The ends of the chutes are equipped with mechanisms which engage the flexible sealing covers over the coal-charging slots in the bunkers. A safety trolley-duck system supplies electric power to the tripper.

Each drive to feeders, conveyors, and tripper includes a motor flexibly coupled to a speed reducer and a chain and sprocket reduction to the head shaft; the crusher is flexibly coupled to its motor. Each of these drives (except for the tripper) incorporates a shear-pin safety device. Each chain drive is enclosed in an oil-tight casing.

Each belt conveyor and the crusher are equipped with a zero-speed (slowdown) cutout arrangement which will shut down the system back toward the track hoppers in the event of a predetermined loss of speed, thereby preventing a pile-up of coal.

All steel plates of hoppers, chutes, gates, and skirts, normally in contact with the coal, are clad on the contacting surface with 20 per cent 18-8 stainless steel.

A check on the crushed coal handled by the equipment is facilitated by a sampling device added to one of the chutes beyond the crusher.

A dust-arresting system minimizes the dust nuisance.

For Future Units

In designing this coal-handling system, careful thought has been given to its expansion to serve generating units installed in the future.

When Units No. 3 and 4 are installed, a duplicate of the foregoing coal-handling equipment will be installed. This new equipment will have its own track-hopper pit arrangement with feeders and dribble conveyor, but the new inclined belt conveyors will utilize the present tunnel, galleries, crusher house, and junction house. Also, the present bunker-belt conveyor, tripper runway, and charging-slot seals will be extended.

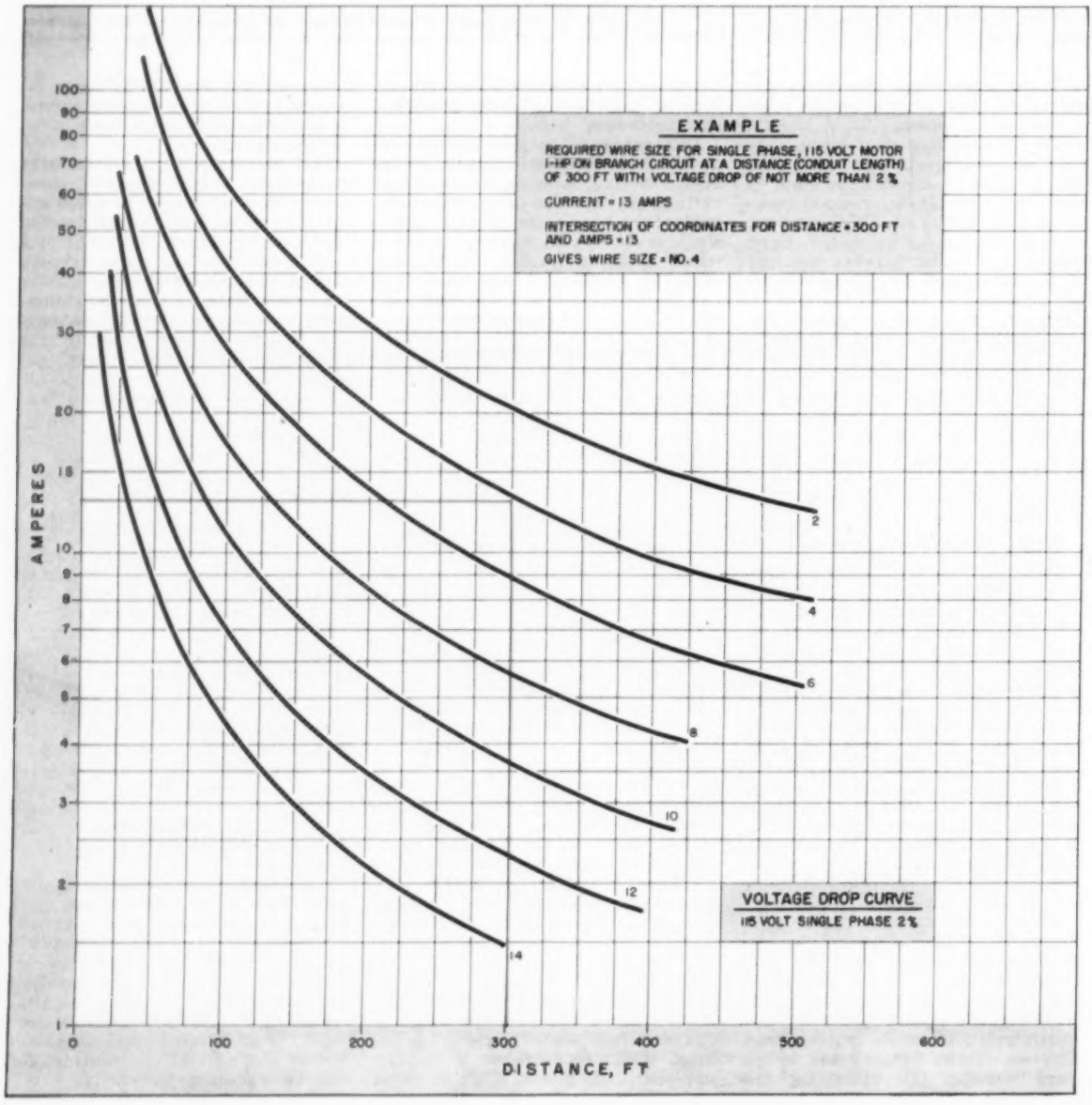
The entire coal-handling equipment, with drives, motors, and electrical limit-controls, was designed, furnished, and erected by the writer's company, under the supervision of Burns & Roe, Inc., the consulting engineers. Design of the structural steelwork for the belt conveyor galleries, and crusher and junction houses was part of the contract for the coal-handling equipment.

Why Do Unnecessary Work? These Charts Avoid Volt-Drop Figuring

CHART BELOW is one of a series prepared by a New York firm of consultants for their own use in designing and checking conduit installations. With these charts the maximum conductor length for a given voltage drop can be determined immediately for any particular current value. A worked example is shown on the chart below.

The whole set includes the following: Conductor lengths for permissible voltage drops of 1, 2, 3 and 4 per cent for 115 v single phase, 220 v single phase, and 230 v three-phase circuits; conductor lengths for voltage drops of 1, 2, and 3 per cent for 440 v and 550 v three-phase circuits; and conductor lengths for drops for 1 and 2 per cent for 2300 v three-phase circuits.

The original charts are sized 7 in. by 10 in. and are printed on finely graduated cross-section paper for accuracy. The complete set costs $2. If you are interested in obtaining a copy, don't send any money to us, but just write "Voltage Drop" on one of the prepaid post cards elsewhere in this issue, mail it to us, and we'll gladly give you the name of the consulting firm that is making these charts available.



More on Chain Drive Lubrication

In a previous article author described operating conditions of modern chain drives. Here he tells how to select most effective lubricant for each type of drive

By A. F. BREWER*

Fig. 1. Chain drive on hammer mill. Chain runs up to 5030 fpm and lubrication is by drip feed only

PRIMARY requirement of a chain lubricant is that it shall penetrate throughout the clearance spaces of the rollers, rockers or sliding surfaces of the links. It is no good applying a lubricant to the surface of a chain if it cannot penetrate to all the wearing parts due to its viscosity and the clearance between these parts.

For the Pintle Type

The simpler designs of chain such as the detachable and pintle types may or not be lubricated, according to the nature of their service. Wherever possible, however, it will be advisable to try to lubricate them, unless they actually operate in contact with an excess of foreign matter; here a lubricant would do more harm than good. For detachable and pintle chains a relatively heavy gear lubricant is often most effective, although in dusty or dirty conditions chains should be cleaned regularly to remove accumulation of contaminated lubricant. Otherwise the links might "ride" on the sprocket teeth due to excessive wear and pitch elongation.

For Roller Chains

The modern roller chain is a precision mechanism; and as such, its lubrication is always important. When such chains are enclosed, it is easy to maintain lubrication because means are provided for oil circulation. Normally they can be well protected (according to temperature) by a good quality straight mineral or additive type of motor or industrial oil ranging from 300 to 1500 seconds Saybolt Universal viscosity at 100 F.; chain manufacturers talk in terms of S.A.E. 20 to 50.

Not all roller chains are enclosed however; some operated exposed. Then the lubricant can be applied by brushing uniformly over the wearing surfaces while the chain is operating slowly. When heavier gear oils are used in such service to withstand excessive throw-off, it may be necessary to heat them before application to help spreading and penetration.

For Silent Chains

Silent chains are generally enclosed in a relatively oil-tight casing. The speed of operation is sometimes regarded as a guide as to whether a casing should be used. However, in service where dust, grit or other foreign matter is present, a casing is always advisable whatever the speed. Naturally, a chain which operates in a dust-proof, oil-tight casing which is equipped with some form of automatic lubricator will function most efficiently and require the least attention.

Because clearances in silent chains are usually very small, it is advisable to use a fairly fluid lubricant. When chains are encased, if they are to be bath lubricated, a medium bodied product having a viscosity of from 150 to 1500 seconds Saybolt Universal at 100 F. will be suitable. Where exposed, or encased but not submerged in oil, a light gear oil should be used. Considerable difference of opinion often arises as to the use of greases or other semi-solid products. In many cases these would serve the purpose, especially on chains that have sufficient clearance to enable proper penetration. But it can be appreciated that the lubricant must have a certain ability to flow, and capillary action cannot always be depended upon to bring about proper penetration to the pins, bushing or rockers, etc.

Maintaining Lubrication

An effective type of casing chain-lubricator makes use of the principles of splash lubrication by means of a disk attached to one side of the main shaft. As the sprocket wheel rotates the disk dips into the oil in the the base and throws it on to a collector plate from which it drains to a gutter for distribution by continuous and uniform dripping upon the inner side of the chain. In casings of this type the oil level is below the chain; the disk dips into a depth of ¼ to ½ in. This method is illustrated in Fig. 1.

Other types of casings depend upon bath lubrication, as shown in Fig. 2. Here the oil level should be about half way above the lowest part of the chain.

Casings which are used on high speed chains are often equipped with an oil pump. Forced lubrication is thus attained, the oil being sprayed continually upon the chain.

Certain manufacturers treat their chains with lubricant before they leave the factory in order to give them a good start in life. Roller chain manufacturers use a lubricant containing a rust preventive, to protect the chain parts against rusting or corrosion in transit or storage, and to provide initial lubrication in service. Usually a soaking bath is used, the chains being immersed long enough to allow penetration to all interior parts. Working the chain in the

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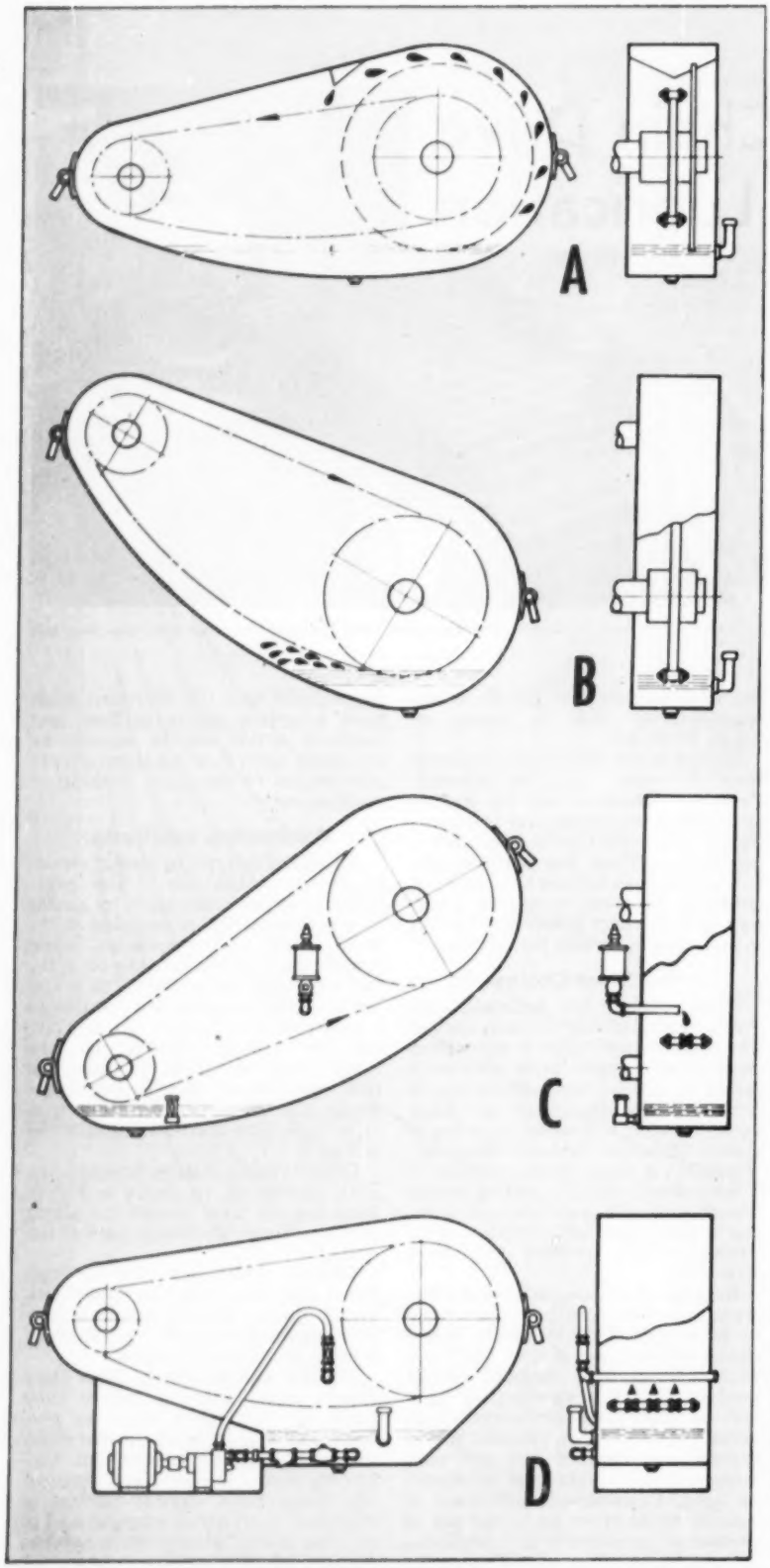

A. Slinger disk lubrication. Oil is carried by a disk from sump to the trough from which it drips on chain
B. Bath-type lubrication. Chain dips into the oil pool in the casing, thus ensuring continuous lubrication
C. Drip lubrication. Lubricator is of normal type and gage glass shows when casing must be emptied
D. Forced or circulating lubrication. This is the most efficient for the majority of high speed operations

lubrication is suggested to promote complete penetration. Where a bath of warm lubricant is used, allow the chain to soak long enough to come up to temperature. Controlled heat is important, because overheating could affect the hardness of the chain parts.

When it is impossible to remove a silent chain for such treatment, the bearing or driving surface should be brushed or otherwise treated with a light uniform coating of lubricant about once a week or more often if necessary.

If this is done during slow operation, considerable penetration will occur to all the joints through the combined effects of bending and capillary action.

Importance of Rigidity

Rigidity is an important feature in many chain installations. Bearings must therefore be securely anchored to prevent shaft vibration or possible shortening of the distance between centers. In making such a roller or silent chain installation the shafts and sprockets should be leveled; measurements being taken between shafts on each side of the sprockets in order to bring them directly parallel, then the sprockets are lined up accurately by laying a straight edge across their sides. Alignment should be checked periodically after the chains have been in operation in order to make any necessary corrections and prevent wear on individual links from becoming serious.

Effects of Wear

Most common reason for chain replacement is mutual wear of pins and bushings, resulting in pitch elongation and ultimately improper fit of chains and sprockets. In a well lubricated chain even at high speeds this rate of wear, as indicated by pitch elongation, is very slow. Sprocket wear in turn occurs only as a result of chain wear in a well designed drive, and except where a roller chain is exposed to abrasive dirt or grit, lubrication of the external surfaces of the chain is not important.

Powdered Metals

One of the latest innovations in chain assembly has been the use of sintered metal bushings. The porosity of such materials is an advantage where chains are used on food machinery and in other operations where perishable products are handled. Oil drip or splash on such products would obviously be harmful. By using a metal structure which is porous and capable of retaining a certain amount of oil, over-lubrication is less apt to occur and yet the chain parts are claimed to be amply protected.

For illustrations the author is indebted to Diamond Chain Co., Inc., Link-Belt Co., Ramsey Chain Co., Inc., Whitney Chain Co., Chain Belt Co., and the Morse Chain Division of Borg-Warner Corp.

Fig. 1. At ASME President's Luncheon, a Council member (standing) greets Lewis K. Sillcox (seated left) incoming 1954 president of ASME and Mrs. Charles M. Hickox, (seated right), president of the ASME Women's Auxiliary

Fig. 2. President Frederick S. Blackall (far left) greets ASME lecturers Glenn Murphy, Jesse Ormendroyd and C. O. Dohrenwend, while Past President R. J. S. Pigott watches (far right) a detail of the largest society meeting

ASME Holds 74th Annual Meeting

ATTENDED by over 8,000 engineers, the largest annual meeting in the history of the American Society of Mechanical Engineers, its 74th, was held in New York City, November 29 to December 4, 1953. Some 290 technical papers were presented, the sessions overflowing from the headquarters in the Hotel Statler into the Governor Clinton and the McAlpin hotels.

Power engineers at the meeting turned out *en masse* for interesting and informative sessions on: power test codes, fuels, controlled circulation boilers, residual fuel oils for the gas turbine, outdoor power plants, boiler feedwater studies and nuclear energy power plants.

There was much interest in the frequency response symposium. The American Rocket Society, an ASME affiliate, held numerous sessions and covered rocketry problems in great detail.

Lewis K. Sillcox of The New York Air Brake Co. was elected president of ASME for 1954 succeeding Frederick S. Blackall, Jr. New directors-at-large are Frank L. Bradley and Robert B. Lea, and several new regional vice-presidents were also elected. Various honors were bestowed on members for outstanding contributions to the profession and to society.

In the annual business meeting of the society, reports were made on the possibilities of establishing a new national engineering center to replace the outgrown New York headquarters. The ASME Council has voted that in any such action it will unite with the other three founder engineering societies. No definite decision has yet been reached, but specific proposals for a new national engineering center have been received from several cities and are being carefully evaluated.

Much interest was shown in a paper on Design of Chimneys to Control Downwash of Gas by Robert H. Sherlock, reporting wind tunnel analyses of smoke emission from chimneys over several years. Pictures showed action of the smoke plume from one or several stacks. This work has resulted in effective use of nozzles on chimney tops of several utility stations and further work is being done.

Economics of Ash Handling was discussed by L. E. Mylting; and a new magnetic impulse rapper for precipitators, to eliminate stack puffs and produce a more continuous discharge, was described by H. J. Hall.

Sessions on frequency response covered a technique in measurement that has received much attention recently. It results from the discovery that parts of all equipment respond to vibrations and from this response the performance of the equipment can be predicted when the parts are put together.

This discovery has produced a group of experts called "wigglers." Many of these wigglers from America and Europe presented papers on various phases of this subject. The fundamental theories were explained by Rufus Oldenburger and others. Practical applications to a hydraulic control system were shown. Also reported was an analysis of the complete Swedish electrical transmission system by this method, showing its use in analyzing turbine governing and control.

For the present, many of the existing gas turbines now operating in the U. S. will burn residual fuel oil and much study is being given to prevention of corrosion and deposits from the ash in this oil when burned in the gas turbine. A symposium, to be reported in detail in a later issue, heard gas turbine users, manufacturers and oil suppliers report. Eight locomotives have been operating on a modified residual oil with availability of about 80 per cent. Good results are reported from stationary plants using a modified residual. Specifications for this oil were recently revised. Latest development is operation of one gas turbine locomotive on propane gas. Work is going forward on a small gas turbine locomotive with mechanical instead of electric drive. A 4500-hp mobile gas turbine plant to furnish shore power for U. S. Navy stations is being developed.

One of the most crowded and important sessions was devoted to manpower and its effects on operating costs in steam power stations. In a masterly paper, V. F. Estcourt showed how the tremendous gains in equipment efficiency are reaching the point of diminishing returns and therefore closer attention to effect of basic plant design on operating personnel is necessary. He showed how various combinations of centralized and semi-centralized control affect number of operators, also the way arrangement of equipment affects the total station force.

In a panel discussion of this paper, G. V. Williamson brought out the importance of maintenance and the men required for it.

Henry Riley discussed effect of system conditions on manpower; Jefferson C. Folkner and J. D. Williamson also presented data.

The panel brought out some of the pros and cons of centralized control and showed how there is a wide variation in manpower from about 700 kw of capacity per man to about 2,000 or 3,000 kw per man in different stations, depending on design and maintenance. Data on this will be given in later issues.

The power engineers attended in force a fine session on the controlled circulation boiler at which W. H. Armacost described the early installations of the unit and some of the recent ones such as those at Chesterfield, Kearny and Oak Creek stations. This was followed by a description of the Chesterfield unit by W. F. Ryan and T. E. Crossan. Mr. Ryan showed that the unit was selected to save

ASME Holds 74th Annual Meeting *(Continued)*

money and improve operation and presented data on weight, size, operating features to demonstrate these had been achieved.

F. P. Fairchild then described the new Kearny station using controlled circulation boilers. Both Kearny and Chesterfield use reheat and C. W. Elston gave details of the reheat turbines at both stations.

A symposium was held on experience with outdoor steam power stations. Louis Elliott reviewed the building of outdoor plants by his company, including, through 1953, some 70 stations having 164 steam generators and 155 turbine generators. B. G. A. Skrotzki reported on a survey of outdoor plants to be built in the future. Other discussion was given by F. W. Argue, Edward C. Duffy, W. F. Friend, G. A. Gaffert and V. F. Estcourt, M. K. Drewry, H. F. Hiebeler and others.

There are problems in preventing freeze-up, in protecting personnel during maintenance work, in centralizing control and others. But on the whole, the engineers felt that in many cases savings in building costs of $5 to $8 per kw could be made, although one engineer evaluated the heat saving by enclosing the equipment at about 94 per cent of the enclosure cost. The majority opinion was that, despite some difficulties, the operators liked outdoor plants and found them easy to operate and maintain. Various combinations of partially enclosed and completely outdoor plants were discussed.

Air pollution in New York City, London, Los Angeles and in Canada was covered by several papers. Lubrication and turbine oil received attention and data were given on new bearing constructions and a new type of turbine oil. Piping flexibility, effect of high temperatures on metals, action of water and chemicals on steels, pump and compressor vibration all came in for a share of attention.

Comic Characters Help Explain Water Treatment

THOSE WHO FIND boiler water conditioning a complicated study and sometimes a dull one will be interested in this method of teaching developed by Thomas H. Waldron and used in the "Fundamentals of Operating Engineering" course he conducts at Wright Jr. College in Chicago.

Using cartoon characters to identify the impurities found in Great Lakes water, Mr. Waldron illustrates by rapid cartoon sequence the manner in which each impurity causes damage under conditions found in a boiler, and the methods that can be used to prevent this damage. In addition, slides of actual testing equipment and procedures are included to demonstrate the practical application. The entire slide series is in color, providing an effective and popular method of presentation.

The slide-lecture does not pretend to be an exhaustive study of boiler water chemistry; it was designed to stimulate interest in what is often considered a mysterious subject among boiler operators. The results have justified the method, as men with little knowledge of chemistry have been able to follow and remember the subject when it has been presented in this way, and the presentation is colorful and novel enough to retain the interest of those who have made a study of boiler water conditioning.

The cartoon shown in Figure 1 is accompanied by this explanation: "Let us look at the culprits responsible for our potential problems and learn to recognize them by their acts of malicious mischief. First are the Carbonate twins, Calcium and Magnesium. Together they represent the largest total of incrusting solids found in our water supply. Next we see Silica, a particularly vicious individual. Also, Calcium Sulphate, one of the severe scale-forming minerals. Last, but by no means least, are the excessive sludge accumulations. Each individual in this show-up is responsible for his own peculiar type of boiler damage, and by their fruits we shall know of their presence. We will review them individually, to see how they act, and the type of protection necessary to render them harmless."

The action taking place in Figure 2 is explained in the following manner: "Sodium Sulphite is often used to catch the elusive Oxygen that has escaped from the heater and reached the boiler. By combining with Oxygen, Sodium Sulphite is converted to Sodium Sulphate, a non-corrosive and soluble impurity."

This slide-lecture, combined with a panel discussion of specific water treatment problems, is available for presentation to organizations interested in the technical and practical aspects of boiler water conditioning. Readers may obtain additional information concerning Mr. Waldron's methods by writing to the Editor, POWER ENGINEERING.

Fig. 1. These are the culprits who cause most of our boiler feedwater troubles

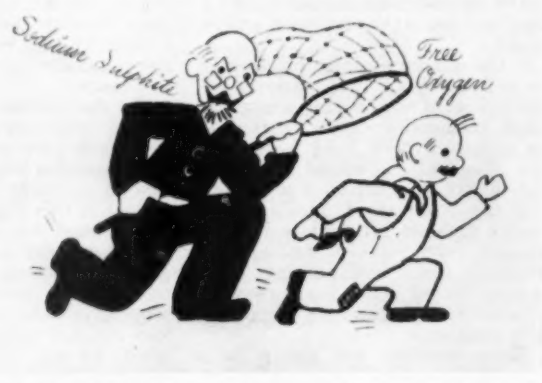

Fig. 2. Sodium Sulphite catches elusive Oxygen that escapes into the boiler

GE Takes Its Own Distribution Medicine

Here's an example of good modern power distribution for the small plant. Outages are almost impossible, equipment can be maintained without interrupting supply, and there is plenty of room for expansion

Fig. 1. Built-in panel housing motor starter group

Fig. 2. 1500 kva double-end load center unit

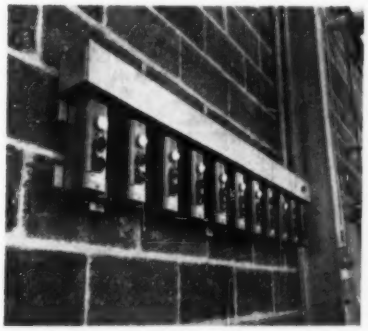

Fig. 3. Neat push-button bank for fans and heaters

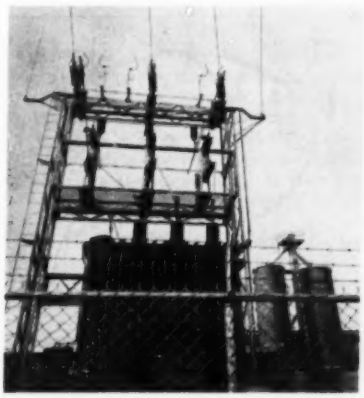

Fig. 4. 5000 kva, 44/4.8 kv incoming transformer

POWER FAILURE in almost any plant means loss of time and material, but few need an uninterrupted supply more than a plant manufacturing permanent magnets, where failure of any of the electrically operated ovens and furnaces would result in very costly losses.

This need for continuous supply was one of the main factors influencing distribution system design for the new magnet plant at Edmore, Mich., which the Carboloy Department of General Electric Company recently opened for production.

Power comes to the plant at 44,000 v. It is stepped down to 4,800 v through a 5,000 kva substation, from where it is distributed, via a switch house and magna-blast breakers, to three double-ended load center substations — two 1500 kva and one 2000 kva units.

Fig. 1 shows the distribution layout. Note how each unit substation has two feeds. If one transformer breaks down, the entire load on each load center can be carried by the other transformer. Note also how, by opening the transformer breaker, the defective transformer or cable can be isolated and repaired without a complete power shutdown. All breakers, both the magna-blast breakers in the primary switch house and the feeder breakers in each load center unit, are of the draw-out type, thus permitting maintenance without power interruption.

The double-ended load centers are located as close as possible to the centers of load throughout the plant, and it will be seen from the diagram that provision has been left for both unit substations and new feeders to allow for future plant expansion. The main feed from the high voltage outdoor substation to the indoor switchroom consists of two cables, each of which could carry the entire plant load in an emergency.

Two types of distribution system are used in the Edmore plant. Wherever possible, flexi-power bus duct is used, and it is generally carried under conveyors, where it is accessible and easy to install. Where this was not possible, and where unit loads are too large for efficient use of bus duct, fused power panels have been used.

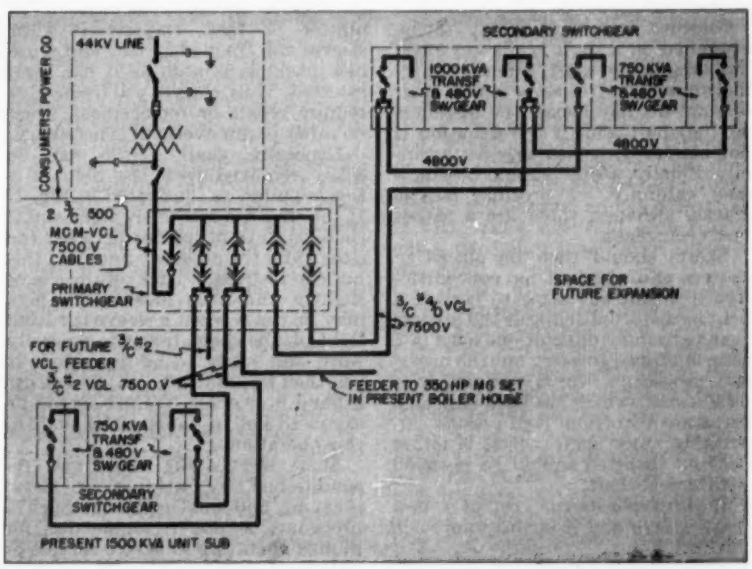
44KV LINE
CONSUMERS POWER CO
SECONDARY SWITCHGEAR
1000 KVA TRANSF & 480 V SW/GEAR
750 KVA TRANSF & 480 V SW/GEAR
4800V
4800V
2 3/C 500 MCM-VCL 7500 V CABLES
PRIMARY SWITCHGEAR
SPACE FOR FUTURE EXPANSION
3/C #4/0 VCL 7500V
FOR FUTURE 3/C #2 VCL FEEDER
3/C #2 VCL 7500 V
FEEDER TO 350 HP MG SET IN PRESENT BOILER HOUSE
750 KVA TRANSF & 480 V SW/GEAR
SECONDARY SWITCHGEAR
PRESENT 1500 KVA UNIT SUB

Fig. 5. Diagram of distribution system. Dual feeds to all load centers ensure an uninterrupted supply

What the Power Engineer Needs to Know About . . . . .

Centrifugal Boiler Feed Pump Maintenance

By IGOR J. KARASSIK*

Preceding articles in this series have dealt with the problems related to complete overhauls, measuring clearances, scheduled observation and maintenance. This article, the fifth, gives special attention to shafts, shaft sleeves and packings and tells how to reassemble the rotor and casing after maintenance

AFTER A BOILER feed pump has been dismantled for a complete overhaul, the shaft has to be minutely examined for any signs of wear or irregularities. It should be checked first at all the important fits, such as at the impeller hub bores, under the shaft sleeves and at the bearings.

In some cases the shaft may be damaged by rusting or pitting because of leakage under the impellers or under the shaft sleeves. When the pump is fitted with ball bearings, the shaft may become damaged by turning in the inner race. When babbitt bearings are used, the shaft may wear in the journals or become grooved. The shaft fit at the coupling may become loose from some cause such as excessive vibration. Small boiler feed pumps with stainless steel shafts not provided with sleeves will show wear at the stuffing boxes.

Another important point to be examined on a shaft is the keyways. Twisting of the shaft, excessive thermal stresses, corrosion or even a poor original fit may loosen the impellers on the shaft and, if the situation is not corrected, it will aggravate rapidly. Finally, a shaft should be examined carefully for possible fatigue cracks, although these are a rather rare occurrence.

Shafts should then be placed in centers and checked for concentricity. It is not advisable to correct a bent or distorted shaft, as the process is an extremely difficult one even in a shop equipped to carry out the necessary procedure. Nor is it advisable to weld a shaft which has been damaged because distortion will result inevitably. Any shaft which is either bent or distorted should be replaced with a new shaft.

If the replacement cost of a new shaft is high and if facilities for such repairs are available, it may be possible in some cases to repair the old shaft by metal spraying and remachining. Such repairs should always be carried out with the knowledge of the shaft material and of the appropriate metal spraying methods. After a shaft has been repaired, it must be checked for possible distortion and rechecked once more after complete assembly of the rotor to assure that the shaft nuts have not been tightened excessively and distorted the shaft.

Shaft Sleeves

Shaft sleeves are the parts of a pump most seriously subject to wear and most frequently requiring replacement. After the sleeves have been worn appreciably, it becomes impossible to adjust the packing to prevent excessive leakage. As a matter of fact, excessively worn sleeves will frequently tear and score new packing as soon as it has been inserted. Thus, sleeves will frequently require repair or replacement when no other pump overhaul is necessary.

Generally, shaft sleeves can be easily removed with the help of a sleeve puller, as illustrated in Fig. 1. If the sleeve is extremely tight and if there is an impeller nut between the sleeve and the adjacent impeller, this nut can be used to back off the sleeve slightly and thus loosen it. There may be times when a sleeve is rusted tight on the shaft, but it is generally worn and ready to be discarded. It can then be hammered so as to either expand it or crack it. Care should be exercised not to damage the shaft in this operation.

Shaft sleeves are sometimes reconditioned by welding or metal spraying and final grinding. Such a procedure is not recommended for pumps operating in severe service or unless existing facilities for the final grinding are adequate. Not only is it

*Manager of Multistage Pump Section, Centrifugal Pump Division, Worthington Corporation.

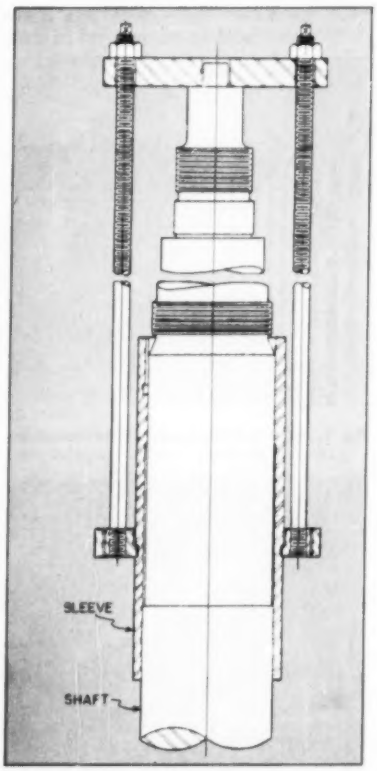

Fig. 1. Shaft sleeve puller works on most sleeves but those rusted on or worn enough to be discarded should be hammered lightly to expand or crack sleeve before pulling. Always respect shaft

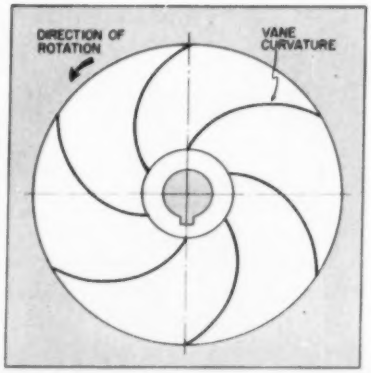

Fig. 2. When reassembling rotor, be sure that the blading curves away from direction of rotation

necessary to assure concentricity of grinding, but also the perpendicularity of the sleeve radial faces with the sleeve bores. The concentricity should be checked again after reassembly on the rotor.

If the wear and grooving of the sleeve is of a very minor nature, say under $\frac{1}{32}$ in., and if the service is not too severe, it may be possible to refinish the sleeve by grinding it slightly undersize. When the sleeve is so repaired, the clearance at the bottom of the stuffing box between the sleeve and the casing or stuffing box throat bushing should be checked to see that the packing will not be forced through the enlarged clearance space into the pump when the glands are tightened.

Reassembly of the Rotor

When the rotor is being reassembled, it is necessary to locate the impellers so that they will rotate in the proper direction. Pump impellers always rotate in a direction away from the curvature of their vanes, as shown on Fig. 2.

Because axially split casing type pumps are made from castings, the distance between the centerlines of the individual stages may vary to some extent between several castings made from the same pattern. Such variations, if they occur, are not of a very appreciable magnitude. At the same time, they should be taken into consideration in the assembly of the pumps, since lateral clearances have to be maintained and since impeller centerlines should be located in their correct position with respect to the corresponding waterways.

This is accomplished by making assembly floor adjustments to the rotor by means of varying the length of the distance sleeves between adjacent impellers. Therefore, in reassembling rotors in the field, all the important lateral distances should be compared with the distances recorded on the pump in its original condition, and the reassembled rotor should duplicate these dimensions. Some manufacturers make it a practice to record these lateral distances on a sketch and to make this record an integral part of the instruction books.

Lateral Clearance

After the rotor and the companion stationary parts, such as casing wearing rings, stage pieces, etc., have been reassembled, the unit should be inserted in the lower half of the casing and the total lateral clearance measured. The thrust bearing is then reassembled, locating the shaft in its proper position.

At this time, it is necessary to see that the total lateral clearance is suitably divided and that the impellers are centrally located within their respective volutes or diffusers. A certain amount of final adjustment can be carried out through the manipulation of the shaft nuts.

One of the great dangers to be avoided in the reassembly of a rotor is the possible distortion of the shaft at the time of tightening of the shaft nuts. The first and most important precaution is that all abutting hub joints of the impellers, spacing sleeves, and shaft nuts (as indicated on Fig. 3) be absolutely square with the shaft axis and with each other.

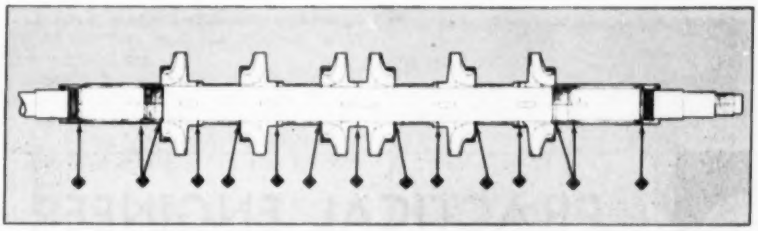

Fig. 3. Abutting joints must be square before they can be tightened on the shaft when assembling the rotor or they will cause shaft distortion and possibly will initiate vibrations leading to rubbing contact

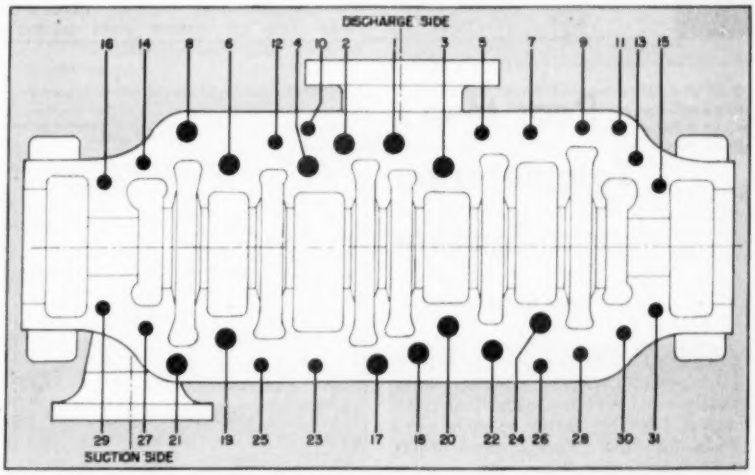

Fig. 4. Bolts in casings of axially-split type pumps must be tightened in a specified sequence as shown

Shaft nuts should never be tightened with excessive force, lest the metal at the abutting joints be crushed. Under such conditions, the severe bending moments applied to the shaft will bow it appreciably, and vibration will develop along with the possibility that the increased deflection will cause contact at the internal running joints.

It is likewise advisable to check the shaft with a dial test indicator when using safety locking screws to avoid bending the shaft in the process. After assembly, the rotor should be supported in its bearings or on centers and checked for absolute concentricity.

Reassembly of the Casing

Tightening of the casing bolts of an axially split casing pump is a procedure which has to be carried out with great care. The method of replacing casing gaskets has already been described in the third article of this series. The order in which the bolts of a typical six-stage pump should be tightened is illustrated on Fig. 4.

After the bolts have been tightened once, they should be gone over once again to insure the tightness of the axial joint. They should then be tightened at least once more after the pump has been brought up to operating temperature and again after the pump has been run at full speed and operated on full pressure.

Packing Maintenance

The following procedure should be followed in repacking a stuffing box:

1. Remove all the old packing and clean the stuffing box. A packing puller is generally a great convenience. Never try to add one or two rings to the old packing; such procedure is a false economy.

2. Make sure that the packing to be used is suitable for the prevailing pressure and temperature conditions. Unless the packing comes preformed in sets, make sure that each ring is cut square on a mandrel of the correct size.

3. Insert each packing ring separately, pushing it squarely into the stuffing box and seating it firmly. A split ring can be used to push the packing rings home. Successive rings should be staggered so that the joints are 120 or 180 degrees apart.

4. Boiler feed pumps are seldom fitted with water seal cages. If, however, one is used, make sure that it will be located directly under the sealing liquid supply connection and that the addition of more packing rings will not displace it.

5. After the required number of

continued on page 100

PRACTICAL ENGINEER AND ELECTRICIAN SECTION

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What is Heat Loss from Cypress Tanks? How Can He Prevent Corrosion in this Steel Stack? What Caused Water Level Irregularities? How Cut FW Heater Losses?

Poor Man's Telemetering System

By L. W. FITZPATRICK *

TELEMETERING is a necessity for large power plants. Small plants usually must forego commercial units because the high initial expense cannot be handled out of limited maintenance budgets.

We had a telemetering unit on order, but since shipment was delayed and our 2,000-ft remote steam line had to go into operation without delay, we hastily designed this system.

Dubbed a "poor man's" telemetering system, it has been improved constantly and identical units have been installed on several other remote applications throughout our system. The main 4½-in. meter is easily mounted on a panel and the small power supply can be attached to the meter behind the panel.

Power consumption is small and a regular 6-v battery can be substituted for the rectifier unit shown.

Selection of a pressure switch at the reference point should be made with care to secure an adequate as well as close differential. In this particular installation operating over 2,000 ft of No. 20 telephone wire, the pressure switches are set at 95, 100 and 105 psi, respectively, with steam pressure nominally maintained at 100 psi.

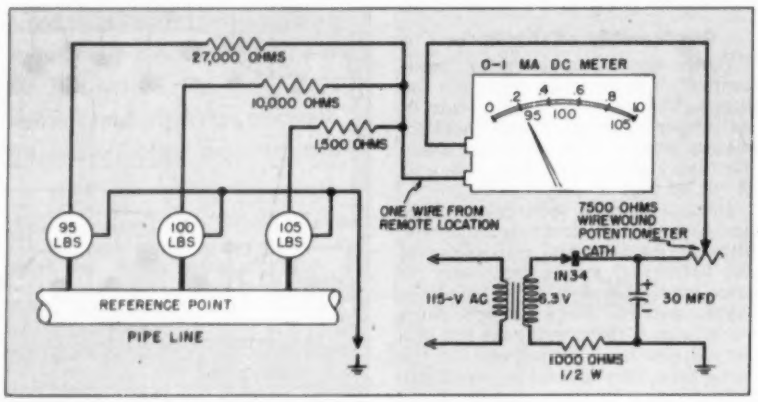
When the pressure switches close, the resistor network instantly transmits the pressure to the 1-ma d-c meter.

A modified scale was secured by photography and pasted over the original meter scale. With 95 psi closing the first switch, the needle deflects to slightly over .2 ma or ¼ scale. At 100 psi the meter reading is ½ scale and at 105 psi, practically ¾ scale.

This resistor combination gives a wide separation and standard 1-watt resistors can be utilized since commercial tolerances do not introduce any appreciable error. All resistors should be installed in a cool spot, preferably in a moisture-proof box at a short distance from the pressure switches. Heat and moisture will in time appreciably alter resistances.

The 7,500-ohm wirewound potentiometer should be installed near the meter to adjust for line resistance and keep the meter needle from overshooting top of the scale.

While originally designed for a steam pressure application, companion units have been installed to telemeter pressure readings from our distribution system for water as well as low pressure building heating. With suitable pressure switches it is possible to show accurately pressure changes from 1 to 1½ to 2 psi remotely.



"Poor Man's Telemetering System" developed by Fitzpatrick can use 6-v battery power or rectified a-c

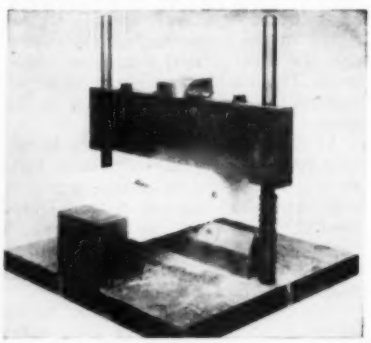
* Chief Engineer, Department of Corrections, State of Missouri.

Brick Shear for Boiler Work

DESIGNED for easy dismantling and portability, a brick shear has been developed by the Bureau of Ships for Navy boiler re-bricking work.

With a 10-in. blade length and 4½ in. distance between the blade and the brick positioning stop, any other dimensions of the shear may be varied. The upright guide posts are threaded and screwed into the base plate to ease dismantling. Spring-type stops prevent jamming of the upper blade head, and also make the operation easier.

Cuts made with the shear are not usually as smooth as those produced with a masonry saw, and the shear is not designed to replace such a saw in the applications where smoothness of cut is essential. However, for work in close areas around the boiler wall, the shear is much more portable, and thus preferable.



(Right) Brick is placed between knives, then the cutter head is dealt a sharp blow to split brick

Boiler Room Dust Pickerupper

By A. E. RICHARDS

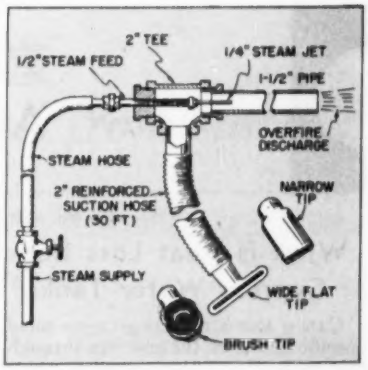
ONE OF THE MOST persistent nuisances in a boiler room is dust. You can brush it, wipe it or blow it, but it will settle back on the same or other equipment. Vacuum hoses help, but they are unhandy for cleaning the tops of boilers, piping, handrails, and other out-of-the-way items.

While working in a plant burning coke breeze (the dustiest fuel I have ever known), I determined to do something about it. I rigged a steam ejector (see illustration) with a 2-in. tee, ½- to 2-in. and 1½- to 2-in. bushings, and other miscellaneous pipe and fittings. The steam jet is made of ¼-in. pipe and is connected to a ½-in. steam feed by a reducer. The jet is aligned with the discharge leg of the tee, and the suction is on the vertical leg.

Steam, air and dust are discharged overfire through 1½-in. pipe in one of the furnace side ports. This jet not only burns the dust but seems to improve combustion in the furnace as well.

We had trouble with the suction hose, which frequently collapsed, until I pirated 30 ft of reinforced suction hose from an under-powered motor-driven vacuum unit. This unit was too weak to help us much, but the suction hose stands up well even under the extreme vacuums the new unit develops.

Steam is transmitted to the ejector through steam hose, and the flow is regulated with a valve preceding the hose. Just cracking the valve slightly develops enough suction to lift anything a normally ambitious burglar can lift. We made our own pickup nozzles, but they can be purchased from any vendor of sweeping equipment.



Steam ejector vacuum sweeper weighs only 10 lb, is portable, develops high vacuum and disposes of dust by injecting and burning it overfire in the furnace. Materials are both simple and cheap

When completed, the unit weighed only 10 lb, was convenient to handle, and made it unnecessary to urge the men into the dust fight as in the pre-jet era.

Flexible Shaft for Remote Valve Control

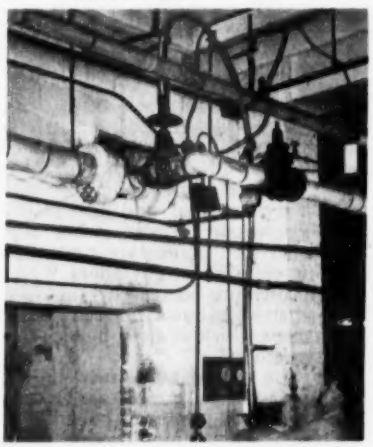
FLEXIBLE SHAFTING, which for years has been used for remotely controlling valves on ships, is now being used for the same purpose in industrial plants.

In the illustration, a steam valve with an 8-in. handwheel is being controlled with a 1-in. flexible shaft with a 9-in. plastic handwheel at the "input" end. Before this shaft was installed it was necessary to climb a ladder to operate the valve. Obviously, the operation is both quicker and safer with the flexible shaft.

At the present, flexible shafting can be used in the control of valves requiring as large as 27-in. handwheels.

If flexible shafting is considered during the initial design stages of an installation, it is possible to lay out piping and valves so that many valves, inaccessible to the operator, can be controlled from one central station. The U. S. Navy has many such installations on combat vessels, but they are gaining popularity in more peaceful lines as well. Flexible shaft remote valve control is now being used in such places as boiler rooms, chemical plants, food processing plants, and paper manufacturing plants.

To obtain a copy of a new design manual giving complete details of the remote control of valves by this method, write the Editor, POWER ENGINEERING, or write "Flexible Shaft" on one of the return postal cards elsewhere in this issue and mail it to us.



This typical flexible shaft remote valve control installation is shown here operating a steam valve

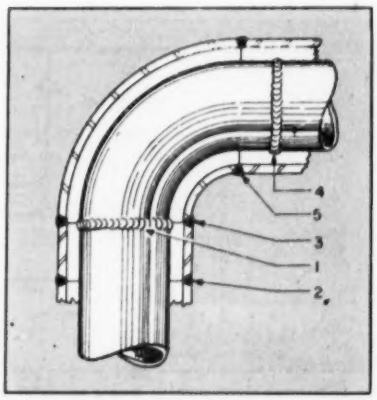
Directional Changes in Jacketed Piping

A SIMPLE and relatively inexpensive way to jacket piping with heating or cooling fluid, where it traverses bends as well as in straight runs, has been worked out by the Engineering Service Division of Tube Turns, Inc. The technique calls for a long-radius elbow for the external (jacket) piping and a short-radius elbow for the inner piping. Their centerlines should match closely and one end of the inside elbow should extend in a tangent beyond the corresponding end of the outside elbow.

Sequence of welding is shown in the illustration. The first weld connects the inside elbow short end to the inner pipe, which should extend somewhat beyond the outside (jacket) pipe. The next weld connects a short nipple to the outside pipe on that end to extend the jacket as far as the first weld. At this point, the external elbow is welded to the jacket (see weld No. 3).

Weld the long tangent of the inside elbow to the inside pipe with the fourth weld, and then weld the jacket pipe to the jacket elbow on that end.

Jacketed fittings fabricated in this manner eliminate the need for steam or coolant jumpers around elbows and eliminate the flanged joints which are hard to insulate. The absence of flanges permits operation with lower heat loss or absorption and minimizes expansion and contraction problems. Lower fabrication costs are said to result from use of this type jacketing.



Welding sequence for new elbow-jacketing method

QUESTIONS AND ANSWERS

Question No. 518

What is Heat Loss from Cypress Water Tanks?

CAN Q AND A readers give me some specific figures on the heat loss through the walls of outdoor, wooden water storage tanks built of cypress? We have two such tanks at our plant, each holding 20,000 gal.

I have some information that indicates the heat loss through 3 in. of cypress is less than that through 3 in. of magnesia insulation. But every once in a while someone starts an argument with me about this and I should like to have some authoritative data.

In winter, of course, we heat the water in one of these tanks just enough to prevent it from freezing. In the other one, however, we maintain a year-round water temperature of 150 F for various process uses. I want to know how much heat we are losing from these tanks as they stand outdoors.

Massachusetts F. C. H.

Question No. 519

How Can He Prevent Corrosion in this Steel Stack?

HOW CAN I prevent corrosion in the inside of my steel stack and boiler breeching when burning hogged fuel that has previously been soaked in salt water?

Washington W. A.

Editor's Note: — Perhaps one of you readers would like to explain (for the benefit of the editor) what sort of flue gas analysis could be expected while burning such fuel. Information on the relative costs of any suggested remedies would also be appreciated. Some obvious corrective measures suggest themselves, but the more obvious they are, the more costly they seem to the editors.

Answer to No. 514

What Caused Water Level Irregularities?

Check Installation of Pressure Governor—Wayne

THE FOLLOWING are offered as answers to M. E. R.'s questions regarding erratic operation of a boiler and its accessories:

1. M. E. R. says boiler pressure was above normal and the safety valves opened. He also states that the boiler feed pumps are controlled by differential steam governors. When steam pressure increased, the feed pump slowed down reducing displacement which allowed boiler pressure to drop.

For the typical boiler installation, pump discharge pressure is 15- to 20 per cent higher than boiler pressure to overcome pipe friction losses and static head. A direct-acting steam pump controlled by a differential governor has a constant ratio between total steam pressure and total liquid pressure. The product of unit steam pressure and steam piston area is greater than the product of unit liquid pressure and liquid piston area plus mechanical friction.

2. With the safety valves popping to relieve pressure, it was still necessary for the pumps to deliver water to the boiler. When the pump governor operates at reduced steam pressure, the ratio of steam to water pressure remains constant, but the pump delivery is reduced by the slowing down caused by reduced steam pressure. The reduced pump displacement occurring concurrently with the safety valves blowing caused the water level to drop. The illustration shows the correct way to install a pressure governor when located above the steam header (dotted lines) and when located below the steam header (solid lines).

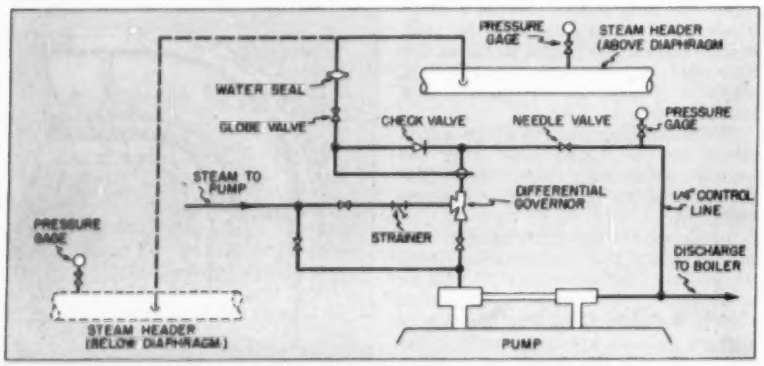
3. This answer is related to the preceding answer. As the boiler pressure dropped, the safety valves closed. The pump displacement did not increase immediately but with the valves closed, water level was restored eventually.

4. Erratic water level resulted from surges due to safety valves popping without pump discharge regulation in direct proportion to the pressure within the boiler.

5. M. E. R. admits the feedwater flow meter had been erratic in its readings before. It is possible that the leads from the header to the orifice taps are not piped correctly and permit air pockets to form giving pulsations or surges. Proper slope of orifice leads to permit venting of non-condensable gases is required. I suggest M. E. R. review the installation with the meter manufacturer and make the necessary corrections to give accurate metering.

Brooklyn, N. Y. H. B. WAYNE

Questions and Answers is a section devoted exclusively to those problems which you have *not* solved. We print them without revealing your identity, and we pay the engineers who answer them for you. These answers can save you costly experiments by bringing the experience of many to bear on each problem. Whether submitting a question or an answer, however, always remember to include your return address.



H. B. Wayne's sketch showing proper connection of a pressure governor. Dotted line represents piping layout employed if the diaphragm is located above steam header; follow solid lines if located below

Sticking Non-Return Valve—McClelland

IT APPEARS evident from M.E.R.'s description of his problem that all or most of his trouble can be attributed to the sticking of the non-return valve. Details of the automatic combustion controls and feedwater regulators were not given, but in the following discussion it is assumed that the controls varied the firing rate of the faulty boiler while the other boiler was fired at a constant rate, and that feedwater regulators were in use on each unit.

Events occurring on this particular day might be explained in the following manner:

(1) Shortly before or at about

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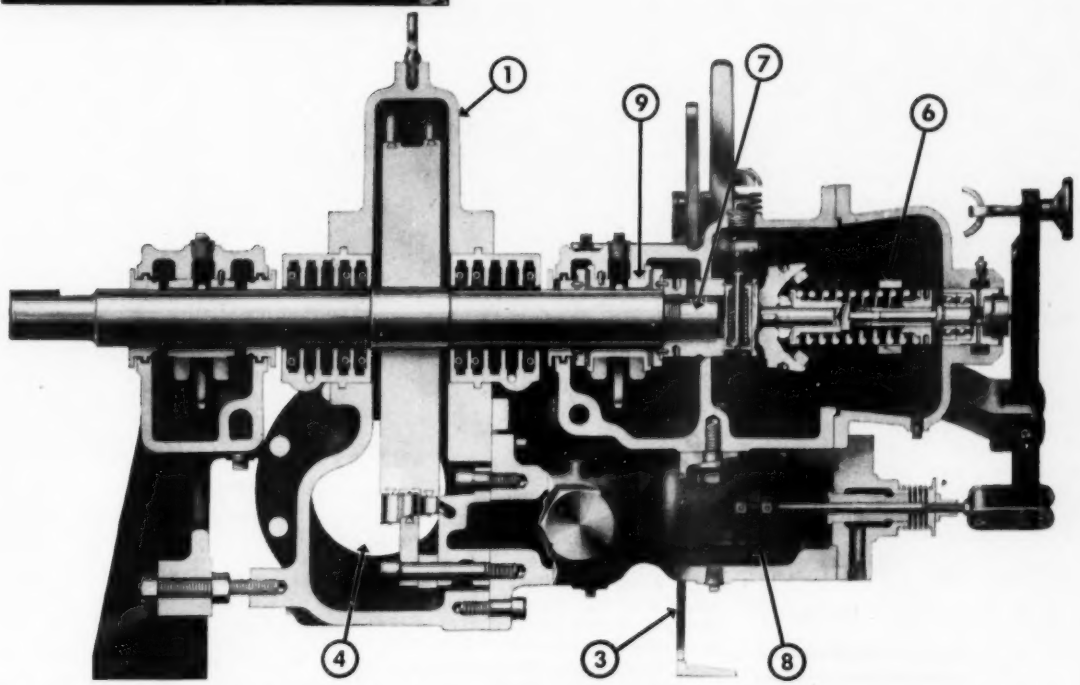
can be ordered from stock



1 Case and Cover Split Horizontally on centerline for ease of maintenance.

2 True Centerline Casing Support assures distortion-free radial expansion. *Not shown.*

3 Flexible Support at governor end provides for axial expansion.

4 Exhaust Opening either right or left side for installation flexibility.

5 Steam Strainer, protecting trip and governor valves, is *removable* for cleaning without breaking steam connections. *Not shown.*

6 Constant Speed Governor features governor weights pivoted around frictionless surfaces.

7 Complete Governor Assembly is now *replaceable as a unit.*

8 Balanced Single Seated Main Governor Valve has proportional flow characteristics for sensitive, positive control.

9 Shaft Locating Bearing of adjustable double collar type.

Horsepower: 100 MAX
Steam Pressure: 300 PSIG MAX
Steam Temperature: 550F MAX
Exhaust Pressure: 25 PSIG MAX
Speed: 4,000 RPM MAX
Steam Inlet: 2"–250# ASA FLG.
Exhaust: 6"–150# ASA FLG.
Weight: 1,200 LB

Here's the new De Laval HCB Single Stage Turbine which is now "on the shelf" . . . ready for immediate shipment. This mechanical drive turbine is simple, rugged, designed for long economical life and low maintenance. For example, note the true centerline casing support, the replaceable governor, the removable steam strainer. Investigate all the advantages of this versatile driver. It is ready to handle—*at low cost*—a variety of applications in your plant.

Send for new Bulletin 4206
which gives vital facts and figures

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5:00 A.M., at which time the steam load was increased by 4,000 lb per hr, the non-return valve became stuck in a partially closed position.

(2) The sudden increase in boiler pressure due to the closure of the non-return valve caused a drop in water level. Any sudden decrease in steam flow with a resulting increase in boiler pressure will cause a drop in the water level and the opposite conditions will cause a rise in the water level. Under these conditions the rise or fall in the water level is due to changes in the density of the water-steam mixture.

(3) The increased steam load and the partially closed non-return valve caused a drop in header pressure which, through the automatic controls, resulted in the speed increase of the draft fan and supposedly an increase in firing rate.

(4) The increased firing rate caused a further increase in boiler pressure until the safety valves popped and lowered the pressure. The boiler safety valves continued to pop in this manner until the firing rate was reduced and the boiler taken off the line.

(5) The decrease in header pressure and the resulting increase in the feedwater and steam header pressure differential caused a slowdown of the boiler feed pumps by means of the pump governor. Feedwater continued to be pumped to the boilers, but at a reduced rate.

With the above explanation it is possible to answer M.E.R.'s specific questions as follows:

(1) Discharge pressure of reciprocating boiler feed pumps is determined by boiler pressure and the pressure drop through the line, valves and fittings and not by the speed of the pump. Thus the pump discharge pressure would have to be greater than the boiler pressure even though the pump had slowed down.

(2) Water was being pumped to the boilers. This was indicated by the feedwater flow meter and by the fact that the pumps performed satisfactorily when the faulty boiler was taken off the line. Failure to pump by a reciprocating pump because of vapor lock, bad valves, or faulty packing is usually indicated by a sharp increase in speed on one or more strokes. Failure of the valves to open or an obstruction in the line would usually be indicated by stopping of the pump, pump or line rupture, or increase in pressure and popping of the pump relief valves.

Failure of the pump piston shortly after the trouble was most likely coincidental. The facts presented did indicate that the faulty boiler was not receiving adequate water and continued operation would undoubtedly have resulted in low water and possible boiler damage.

(3) Drop in water level was caused by the sudden increase in boiler pressure as previously described.

(4) Erratic water level was most likely caused by the popping of the relief valves with alternate increases and decreases in boiler pressure.

(5) Reasons for the apparent inaccuracy of the feedwater flow meter are not clear. Under the conditions described previously it would be expected that the feedwater flow would be erratic. The feedwater flow chart should be compared with the steam flow chart and if it is found that the frequency of the two flows is the same it can be assumed that the surging in feedwater flow actually occurred. The conditions of hot feedwater from reciprocating pumps with possible dissolved gases make accurate measurement by flow meters very difficult. Measurement sufficiently accurate for operating purposes can usually be obtained by careful installation and maintenance with particular attention to dampening of pump pulsations, provision of a positive liquid seal downstream of the orifice or flow meter, and elimination of vapor or gas entrained in the meter leads.

Tuscaloosa, Ala. G. McCLELLAND

Answer to No. 315

How Cut FW Heater Losses?

Crooks—Heat With Coils, Direct Admission to Trays

IN THE October issue, OE asked how to save feed water heater steam.

I do not believe it would be called good practice to turn live steam into the water through a perforated pipe to assist in heating the water in your open heater. One reason is that any sediment accumulating at the bottom of the heater would be stirred up and keep the feed water dirty. Also, lime deposits are apt to loosen and fall into the feed water. Another reason is that live steam being discharged below the water level would cause cracking and pounding, and be rather noisy.

You state that you do not have any exhaust steam at all at your plant, so I take that to mean that your feed pumps are of the centrifugal type and electrically driven. A duplex pump, being sort of a steam hog, would supply enough exhaust steam to be of great help if you had one in your plant. We use all the pump exhaust at our plant and discharge it into the big low pressure line which provides for the deaerator along with a quantity of live steam at reduced pressure through a reducing valve. The pressure ranges from 3 to 5 psi (steady gauge). I believe that as an aid to your present means of heating, you would be some better off to make up a coil to be submerged in the water at the bottom of the heater (utilize live steam).

You could make such a heater coil by using $1\frac{1}{4}$-in. ells, and long $\frac{1}{4}$-in. pipe nipples, say 18 to 24 in. long. Make the coil square and have about three complete turns stretching it out, like a coiled bed spring. Feed this coil from the bottom end through a smaller line (about $\frac{3}{4}$-in. pipe would be satisfactory). Control live steam by a suitable valve.

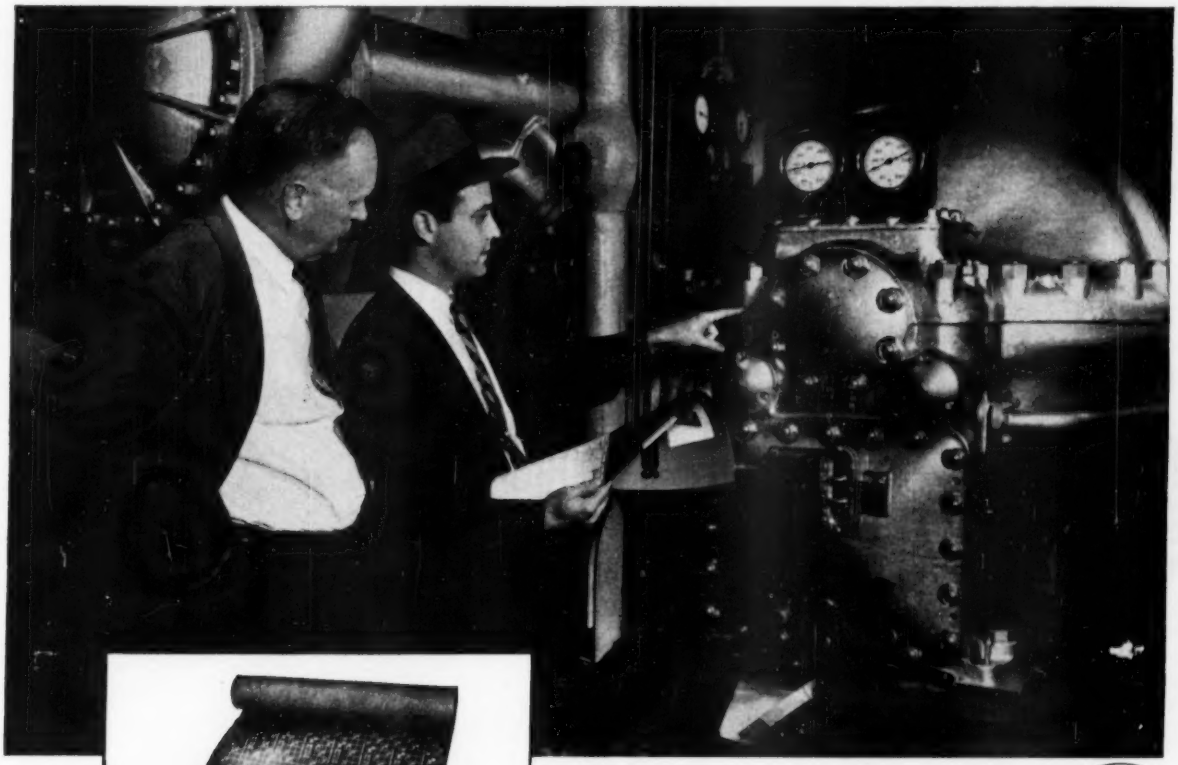
The pipe coil could be made to discharge its exhaust through another section of $\frac{3}{4}$-in. pipe. The end of the pipe could be partly closed off by flattening it and the discharge directed to the trays in the upper part of the heater. I would put some sort of orifice in that hole (exhaust head) to limit the steam from leaving the heater so fast, and get more good out of the steam you now have. The safety valve should be checked out carefully since it has probably been some time since it operated and may not now be operable.

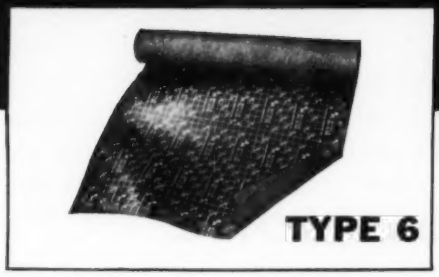
Stow, Ohio W. S. CROOKS

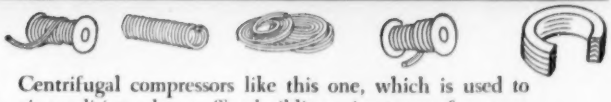
"When I asked for help on this job, I had somethin' a little dirtier in mind"

"Aren't you about through with your homework, Mister Bull o' the Woods?"

R/M's BIG 7 Packing Types meet 95% of all packing needs







Centrifugal compressors like this one, which is used to air-condition a huge office building, give top performance with R/M Packing No. K-68, a gasket material included in Type 6 of R/M's "Big 7" Packing Types.

Let R/M lower your packing inventory

If you are under the impression that you must stock 10, 20, 50 different types of packings, get acquainted with the distributor who sells R/M's "Big 7" Packing Types. R/M's "Big 7" Packing Types have so simplified the whole packing picture that your plant can probably standardize on just three or four. This basic line of just seven field-tested packing types is engineered to give custom-built performance in all but the very rarest packing applications. It can reduce your down-time, cut your maintenance costs, simplify your ordering. Call in your R/M distributor today.

R/M PACKINGS FOR MAINTENANCE PURPOSES ARE SOLD ONLY THROUGH AUTHORIZED R/M DISTRIBUTORS

RAYBESTOS-MANHATTAN, INC., PACKING DIVISION, MANHEIM, PA.

BIG 7 PACKINGS

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada.

RAYBESTOS-MANHATTAN, INC., Packings • Asbestos Textiles • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Bowling Balls

For more data circle 536 on Post Card

CITY WITHOUT COAL

Without coal a great modern city is a helpless cripple. Heat. Lights. Refrigeration. Transportation. Elevators. Signal systems. Telephone. Industry. All these depend on coal.

One modern city came near such paralysis. That was Berlin in 1948 when the Russians thought to strangle it into submission. Of all the cargo flown into Berlin, 64% was coal. Nearly 1,500,000 tons. Enough to fill 30,000 big, hopper coal cars. That coal was like new blood in a dying man's veins.

We don't fly much coal here in America—occasionally to an arctic defense base or a bag dropped to a storm-isolated farm house. Coal is something we have always taken for granted. There's plenty to last a thousand—maybe two thousand years. It is widely distributed; and the great coal-hauling railroads like the C&O are equipped to move it rapidly.

For instance, the C&O has invested many millions of dollars in great coal-handling docks at Newport News and Toledo to facilitate water shipments to Atlantic and Great Lake ports.

Coal is one natural resource you don't need to worry about. It is the one fuel that will always be plentiful.

Bring your fuel problems to C & O

As the world's largest carrier of bituminous coal, the C&O is intimately familiar with every phase of coal use. We have a large staff of experts who will gladly help you to locate the coal best suited to your needs; to help you use it most efficiently; to help get it to you most economically.

Write to:
Coal Traffic Department
Chesapeake and Ohio Railway
2116 Terminal Tower
Cleveland 1, Ohio

Chesapeake and Ohio Railway

COAL...FUEL OF THE FUTURE

For more data circle 538 on Post Card

Prevent heat loss up the stack. Too much or too little excess air means big money in today's boiler plant. It's important to *know* and *control* excess air exactly—regardless of load or fuel changes.

Burn multiple fuels efficiently

When switching from one fuel to another or burning more than one fuel at the same time, only an Oxygen Recorder gives you an undistorted picture of excess air. It measures O_2 directly and continuously, without recalibration.

Hundreds of companies are reaping large savings with Hays Electronic type Oxygen Recorders in their boiler plants. Flue gas sampling systems fit a wide variety of installations.

With the Hays Electronic type Oxygen Recorder you get continuous, highly accurate indication and recording . . . complete compensation for temperature and pressure effects . . . freedom from chemicals or hazardous fuel burning in the analyzing process . . . swift, sure electronic operation.

Write today for Hays Bulletin 52-829-56. Also ask for a dramatic comparison graph which shows that the relationship between O_2 and excess air is practically constant for different fuels.

Automatic Combustion Control
Boiler Panels • CO_2 Recorders
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE **hays** CORPORATION

MICHIGAN CITY, 7, INDIANA

For more data circle 537 on Post Card

Service . . . where and when you want it

PROMPT, experienced service is one of the most important plus values you get when you buy Honeywell instruments. An unequalled organization of trained specialists is always at your call at more than 110 offices in the United States and Canada. Offices are located in practically every large industrial city of the country . . . close to every major production center.

Trained Personnel

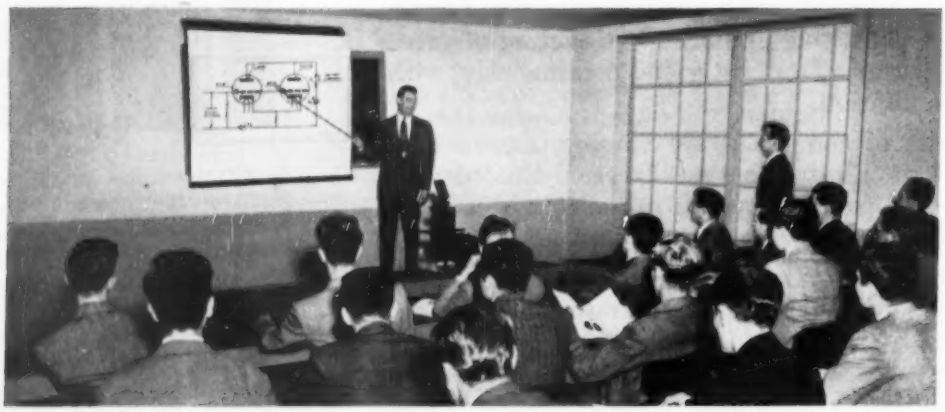
Honeywell service men are schooled not only in the theory of measurement and control, but also in the practical art of keeping good instruments in the best condition. Hand picked men begin this instrument education in an intensive training program in Honeywell factories. After graduation, they serve an apprenticeship in the field offices . . . while they learn still more about instrument maintenance from first-hand contact with plant problems. By the time a Honeywell man arrives at your plant on a call, he's a finished product worthy of the responsibility he bears, and capable of doing the kind of service job that you need . . . and that your Honeywell instruments deserve.

When trouble strikes, a wire or telephone call will bring a service man to your plant . . . often within a few hours. This assurance of prompt action means a lot to your production schedules. You'll never be left out on a limb because of delays in instrument maintenance.

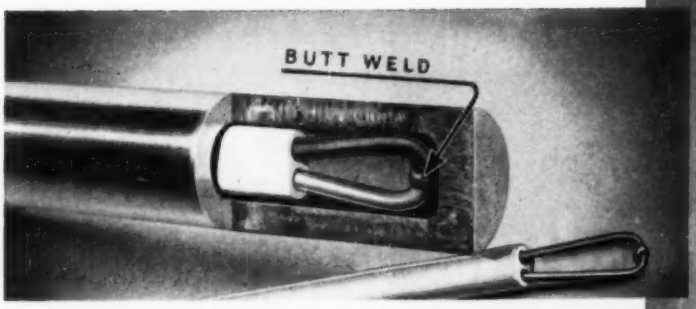
Periodic Service Plan

But why wait for emergencies? Preventive medicine works on instruments, too. And the prescription is simple . . . a Periodic Service Contract, which brings a Honeywell service man to your plant at regular intervals to inspect, clean and adjust any Honeywell instruments you have. The plan is economical . . . can save you many hours of lost production time. Your nearest Honeywell office will be glad to give you full details.

A faster, stronger *for steam*



TRAINED TO SERVE: *In Honeywell's service school, students get a thorough grounding in instrument theory and practice. After graduation, they become part of the most extensive organization of its kind in the world . . . ready to serve you competently and promptly, whenever and wherever you need them.*



FOR getting high-speed, precise measurements of steam temperatures, the Brown butt-welded thermocouple is the ideal partner for *ElectroniK* instruments. This thermocouple's unique characteristics come from an entirely new kind of design, in which the two couple wires are electrically welded together in a butt joint.

The thermocouple is *faster*—because the mass of the junction is much smaller than the usual twisted joint. It's *stronger*—withstands vibration and shock better. And it's *more accurate*—because the loop formed at the joint prevents heat conduction from the junction back to the insulators.

A wide line of thermocouple wells is supplied for various steam plant applications . . . including a series especially designed for high pressure steam lines. All Brown thermocouple wells are precision-machined to highly uniform wall thickness, to guarantee dependability at high temperatures and pressures. They are available in a broad choice of standard sizes and designs, supplemented by special types made to individual specifications.

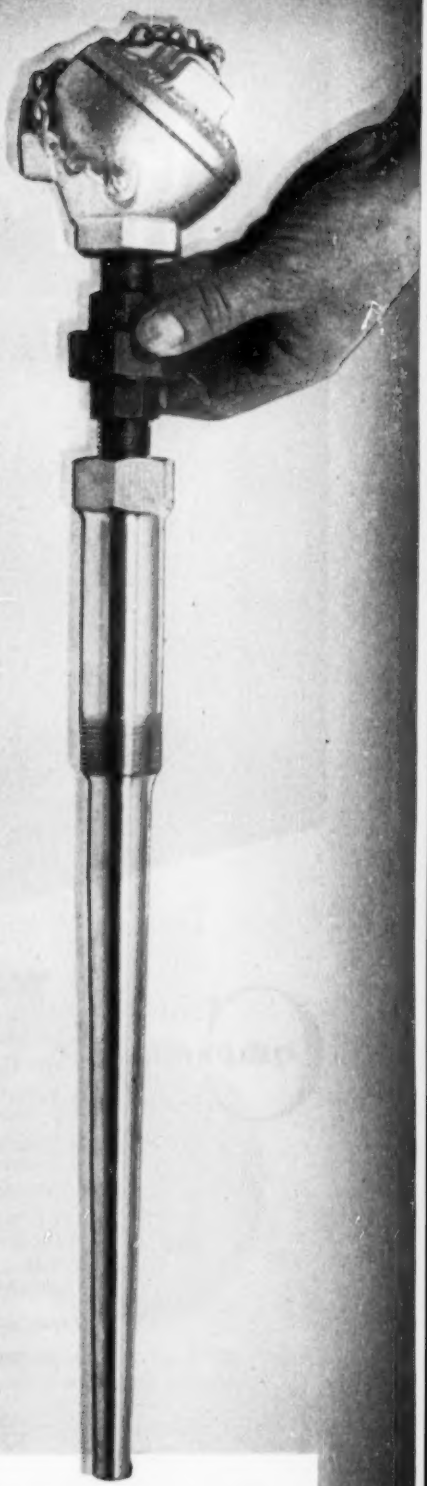
thermocouple *plant temperatures*

For specifying and purchasing all instrument supplies and accessories, you'll find new convenience and economy in the Honeywell Supplies Man—HSM—Plan. Your local HSM will be glad to explain the plan in detail, and to show you how planned buying can save you time and trouble. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4587 Wayne Ave., Philadelphia 44, Pa.

REFERENCE DATA: Write for Pyrometer Supplies Buyers' Guide No. 100-4 . . . and for Specification Sheet No. 200-2 on Thermocouple Wells.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls



STEAM THERMOCOUPLE *has tapered stainless steel well, precision-drilled to highly uniform wall thickness. Inset shows butt-welded thermocouple junction. The small mass gives fast response . . . curved wires prevent heat conduction away to the insulators.*

NEW Richardson
H-39 COAL SCALE

Compare...

7 WAYS BETTER

1. 24" x 24" coal inlet opening—50% greater area—for maximum flow-ability of coal.
2. *All* wiring and controls outside coal chamber.
3. Beam-ratio test facilities *completely outside* coal chamber.
4. Simple, gravity-operated bypass arrangement with no restriction in coal flow to downspout.
5. No drag-links or electrical wiring on weight hopper.
6. Construction of access doors makes it *impossible* for coal dust to spill out on floor when opening.
7. Unequalled nationwide maintenance and service facilities.

That's why you just can't *buy better than a Richardson*

Get all the facts. Write for Bulletin 0352 today!

RICHARDSON SCALE COMPANY
Clifton, New Jersey

Atlanta • Boston • Buffalo • Chicago • Detroit • Houston
Minneapolis • New York • Omaha • Philadelphia
Pittsburgh • San Francisco • Wichita • Montreal • Toronto

Richardson

MATERIALS HANDLING BY WEIGHT SINCE 1902

8616

For more data circle 539 on Post Card

Feed Pump Maintenance

continued from page 89

packing rings has been inserted, install the gland and tighten the gland nuts firmly. Make sure that the gland enters the stuffing box squarely and without cocking, so that the packing is subjected to a uniform pressure on its entire periphery.

6. After tightening the gland, back off the nuts until they are just finger tight. In running in new packing it is advisable to allow quite a bit of excessive leakage at first. Take up the packing slowly, during the first few hours of running, possibly at fifteen minute intervals.

7. A certain amount of leakage is necessary to carry away the heat generated by packing friction. Do not attempt to reduce the leakage excessively, lest the packing burns and scores the shaft sleeve. A stuffing box should be so packed that the leakage is sufficient to form a steady running stream rather than a dribble of drops.

8. If the pump is provided with water quenching glands, stop the supply of quenching water at intervals and observe whether the leakage has not been excessively throttled off. Otherwise, it is impossible to distinguish between leakage and quenching water.

9. Never let unqualified personnel adjust stuffing box glands on the theory that the packing leaks excessively and should be tightened. Repacking and adjusting stuffing boxes should be assigned to specially trained personnel.

Letters to the Editors

continued from page 6

board states from New York to Quebec, only aluminum and chalking white paints were observed as coatings for liquid fuel tanks, with aluminum greatly predominant.

L. G. JONES

Reply to letter of Wright M. Fedder (POWER ENGINEERING, *August 1953, page 101*) *on the relative value of chalking white paint in keeping temperatures of volatile liquids in tanks at minimum temperature.*

Artificial Respiration

IN THE July, 1953 (Vol. 57, No. 7) issue of POWER ENGINEERING an article is found on three methods of artificial respiration. We are now engaged on construction of two steam power units for the Dallas Power & Light Company and our safety program is very active, especially in regards to artificial respiration. We propose to obtain the tear sheets offered by POWER ENGINEERING and make copies by the off-set printing method and distribute them to each man on the two projects.

If the tear sheets are still available and if permission is granted to reprint

You're Always on the Safe Side

WHEN YOU SPECIFY

ASHCROFT *Maxisafe* DURAGAUGES

Here is the gauge that provides absolute protection to the viewer from tube rupture due to any cause.

In this new Ashcroft Maxisafe* Duragauge, an integrally cast solid wall separates the dial from the Bourdon tube and movement. The entire back of the case is covered by a double spring-mounted safety release plate. Teflon coated and tightly fitted on a rubber gasket, the plate is held in place by a knurled knob. If the tube ruptures, pressure less than ½ p.s.i. will force the plate open and vent the discharge to the rear.

Always be on the safe side. Get absolute protection against the possibility of tube rupture — specify the Ashcroft *Maxisafe* Duragauge. The *Maxisafe* has all the long-life durability and precision accuracy of standard Ashcroft Duragauges. It's available in all Duragauge pressure ranges, Bourdon tube materials, case designs (except Types 1179 and 1279), and mountings, in 4½, 6 and 8½ inch dial sizes. Ask for details in selecting *Maxisafe* Duragauges. Phone your local Ashcroft Gauge Distributor.

*Reg.

NOTE THE SOLID WALL

that separates the dial from the Bourdon Tube and movement. Three ¾" lugs on the back flange hold the *Maxisafe* away from the wall and permit the safety plate to release. *The case design also provides easy, quick access to the movement and tube assembly for inspection, repair or recalibration.*

FOR FAST DELIVERY — buy from your Industrial Distributor. He stocks Manning, Maxwell & Moore products locally — saves you the trouble and expense of maintaining a large inventory in your own plant.

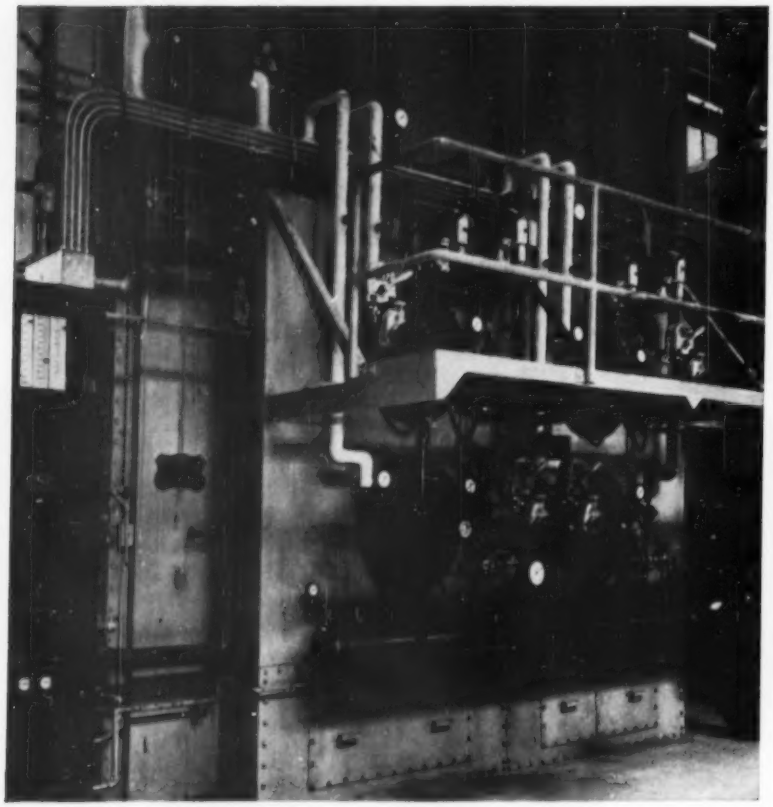
ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

For more data circle 540 on Post Card

ENCO
GAS-OIL
BURNERS
for
LOWER
Fuel Costs



The Enco gas-oil burners in this boiler will burn oil or gas—or both. The change-over is simple and is made according to the availability or cost of these fuels. Thus the plant can avoid a shut-down when one fuel cannot be obtained, or can switch from one fuel to the other according to the relative prices or the cost per btu. Combustion is uniform with either fuel or both, even though steam demands swing sharply—another fuel-saving, money-saving feature.
Other Enco burners offer similar economies for boilers of practically all sizes and types.

We invite inquiries on all burner problems — including those involving a wide range of capacities with a demand for complete atomization. We have had 35 years of experience in this field.

EC 491

THE ENGINEER COMPANY
75 WEST STREET, NEW YORK 6, N. Y.
IN CANADA: ROCK UTILITIES LTD., 80 JEAN TALON ST. W., MONTREAL, P. Q.

For more data circle 541 on Post Card

these articles, please send copies.
Dallas, Texas W. J. WILKIE

Editor's Note: — Mr. Wilkie is Construction Superintendent with Ebasco Services, Inc., in Dallas. Reprints of this article were not ready when he wrote, so he made his own. Now, however, we have our own reprints, have given out hundreds to utilities and industries, and still have a few left.

Putting Ideas to Work

WE WOULD be delighted to receive a copy of "Putting Ideas to Work," the 16-page bulletin of the Battelle Development Corp., described in POWER ENGINEERING for September, 1953, page 7.

Permit us to congratulate and to thank you for the easy, readable, interesting style of writing on this page (*Engineers' Preview*). It is refreshing.
New York, N. Y. VICTOR H. SCALES

Editor's Note: — In view of Mr. Scales' unsolicited testimonial, we thought that he and other readers might like a look at "the paws that refreshes," below.

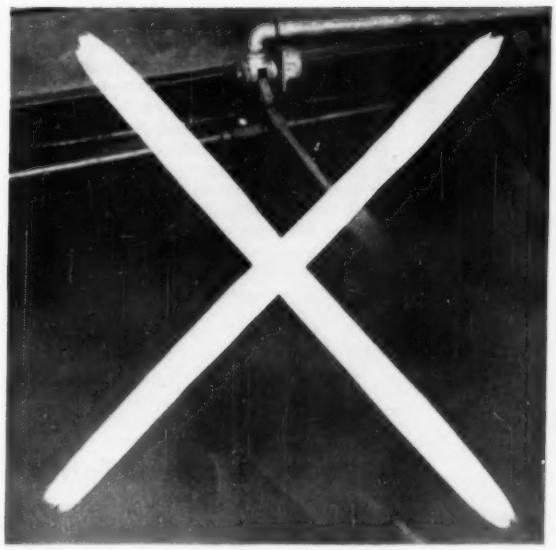
Radials Get Visitors

I WAS VERY pleased with the nice layout you gave my article on radial diesels (POWER ENGINEERING, July 1953 issue). Since its publication we have had a number of visitors stopping to see the plant after reading about it. One visitor flew up in his private plane, which he landed in a nearby field.
Milaca, Minn. D. L. COCHRANE

More Drying Problems

APPARENTLY I must clarify a point made in my article on Silica Gel Drying Problems (POWER ENGINEERING, May, 1953). Mr. Herrmann's letter in the October issue called our attention to the fact that silica gel had much better absorptive properties than Drierite. There is no conflict in our opinions on this subject *when silica gel is made available in the proper type container.* Drierite had that can, and now similar packaging provisions have been made available for silica gel.

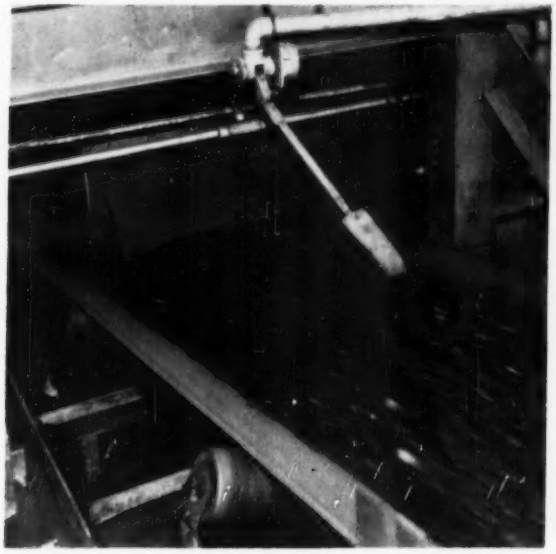
We now receive refrigeration grade



BEFORE—View of Coal Chute discharge onto conveyor belt at a New Jersey generating station without J-M system turned on.

STOP COAL DUST

in your operation at 1/10 the usual cost!



AFTER—Same view as above but with J-M dust control system in operation.

Here's improved appearance for your plant . . . better health for your employees . . . easier handling of your coal supply. A Johnson-March system can control or eliminate coal dust wherever it occurs in your operation *. . . at a cost only 1/10 that of most other dust control systems!*

A Johnson-March system can be installed right at car dumpers, hoppers, crushers, belt galleries or coal piles. Nothing to interfere with normal operations. So amazingly simple the maintenance cost is next to nothing.

Johnson-March systems are installed in many plants to improve the effectiveness of existing mechanical dust collection systems. If you now have no control over coal dust . . . or even if you have a mechanical dust collection system in your plant . . . it will pay you to consider the *low-cost* advantages of a Johnson-March system.

For more information on how a low-cost Johnson-March system can help solve *your* coal dust problems, send NOW for this FREE ILLUSTRATED BROCHURE.

THE JOHNSON-MARCH CORP. PE-6
1724 Chestnut St., Philadelphia 3, Pa.

With no obligation, I want to know the facts about stopping coal dust with a low-cost Johnson-March system. Please send me the FREE ILLUSTRATED BROCHURE.

NAME .....
COMPANY ..... TITLE .....
ADDRESS .....
CITY ..... STATE .....

Johnson March

Specialists in Dust Control

1724 CHESTNUT ST. **Philadelphia 3, Pa.**

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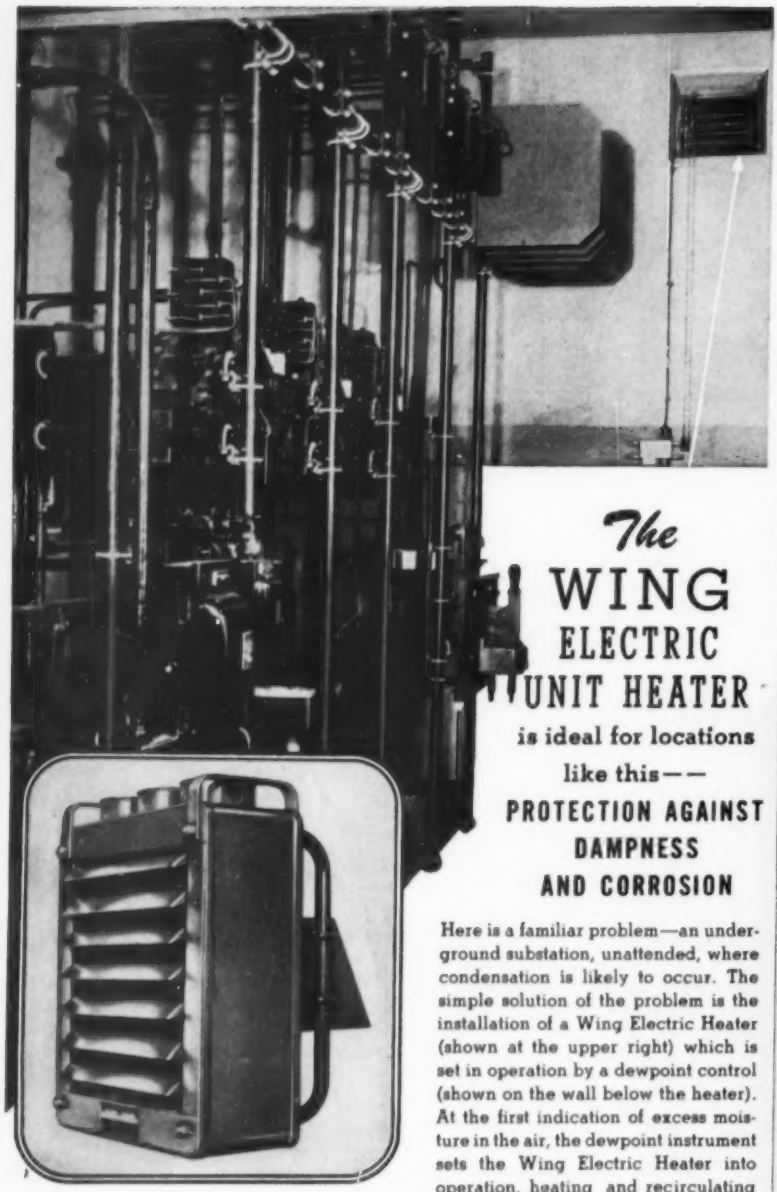


The
WING
ELECTRIC
UNIT HEATER
is ideal for locations
like this——
PROTECTION AGAINST
DAMPNESS
AND CORROSION

Here is a familiar problem—an underground substation, unattended, where condensation is likely to occur. The simple solution of the problem is the installation of a Wing Electric Heater (shown at the upper right) which is set in operation by a dewpoint control (shown on the wall below the heater). At the first indication of excess moisture in the air, the dewpoint instrument sets the Wing Electric Heater into operation, heating and recirculating the air in the room and removing all danger of dampness and corrosion.

Wing Electric Heaters have many applications, not only in the electric utility field, but wherever heat is necessary at remote points or where steam or gas is unavailable or uneconomical.

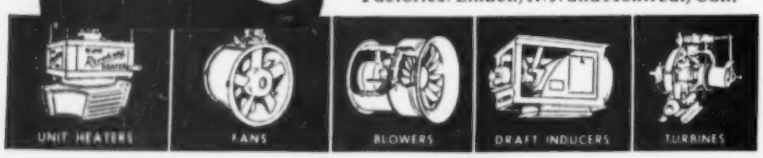
The Wing Electric Unit Heater is made in three types—the Utility Heater shown above, the Wing Revolving Overhead, Downward Discharge Unit Heater and the Wing Electric Duct Heater Section. Sizes from 13,600 Btu/hr to 204,000 Btu/hr.

Write for a copy of Bulletin E-1

Wing

L. J. Wing Mfg. Co.

64 Vreeland Mills Road
Linden, New Jersey
Factories: Linden, N. J. and Montreal, Can.



For more data circle 543 on Post Card

silica gel in fine pour spout cans which prevents spillage and eliminates the excess absorption of atmospheric moisture while the can is open. The old screw containers never seemed to close tightly enough and the resulting degrading by atmospheric moisture (especially here in the deep South) seriously impaired the absorptive qualities of silica gel. We have had similar troubles with calcium carbide containers, which material we are using for a similar purpose.

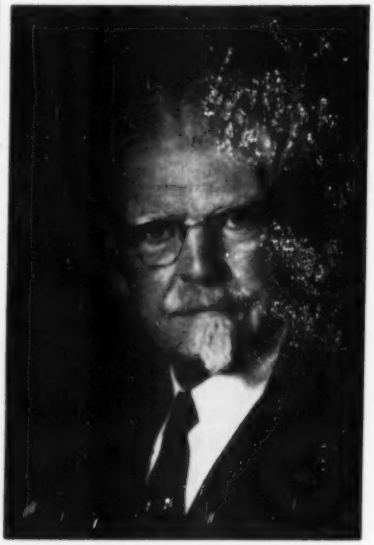
Oak Ridge, Tenn. PAUL C. ZIEMKE

OBITUARIES

David Fettes

DAVID FETTES, 88, for many years chief superintendent and charter associate of Albert Kahn Associated Architects & Engineers, Detroit, Mich., died recently at his home in Detroit. He had been active in the company for more than 40 years.

Born in Aberdeen, Scotland, Mr.



Fettes joined the Kahn organization in 1906 as a superintendent of construction. He helped design the Packard plant, first in industry to use steel and concrete construction; the Hudson Motor and Continental plants, and plants for Ford, Dodge and General Motors.

Surviving are his widow, Marjorie Gifford Fettes, and two sons, David and I. J. Gordon. He was a member of Palestine Lodge No. 357, A.F. & A.M.

Philip Torchio

PHILIP TORCHIO, Jr., 45-year-old commercial vice president of American Gas and Electric Service Corp., died of a heart attack while vacationing at his summer home at Big Wolf Lake, N. Y.

INTEGRAL BONNET CAST STEEL ANGLE VALVE *(upper left)* **Fig. 1333-A.** 1500-pound. The one-piece construction of this compact high-pressure valve eliminates possibility of leakage between body and bonnet. Sizes ¼" to 2", inclusive.

CAST STEEL SWING CHECK VALVE *(upper right)* **Fig. 1361 WE.** 1500-pound. Bolted flanged cap. Heavy rugged construction. Available in sizes 1" to 12", inclusive.

CAST STEEL GLOBE VALVE *(lower left)* **Fig. 3031 WE** for 300 pounds W.S.P. Bolted flanged bonnet. Outside screw stem and yoke. The valves are available in sizes 1" to 10", inclusive.

CAST STEEL PRESSURE SEAL GATE VALVE *(lower right)* **Fig. 16003.** 600-pound. Many proven advantages and exclusive features. Pressure Seal valves are also available in Non-Return, Check, Globe and Angle Patterns.

You're *always* the winner when you select Powell Valves. For every Powell Valve gives championship performance. They have a prize winning record of dependability since 1846.

And there's good reason why Powell Valves are always way out in front—*year after year.* Powell has probably done more valve research, solved more valve problems and makes more types of valves than any other organization in the world.

Shown here are just a few of the Powell Valves that can help you *checkmate the high cost of maintenance and replacement.* They're available through distributors in principal cities. If a distributor is not located near you, just write us. We'll be pleased to tell you more about these valves—and our complete line. The William Powell Company, Cincinnati 22, Ohio.

CONTROLS FOR THE LIFE LINES OF INDUSTRY

..... 108th YEAR

For more data circle 544 on Post Card

GREATER SAVINGS

in Combustion Processes with new, simpler

OXYGEN ANALYSIS

Modernize with

Arnold O. Beckman

OXYGEN ANALYZING SYSTEMS!

Oxygen content of the flue gases is widely recognized as the most direct and accurate indication of correct air-fuel ratio. However, maximum benefit from this measurement requires: (1) An Analyzer that is rugged, accurate, field-proven . . . (2) A Sampling System that is simple, responsive, trouble-free.

Now Arnold O. Beckman offers you the industry's most advanced Analyzer, coupled with a Sampling System that is unexcelled . . .

Arnold O. Beckman Oxygen Analyzers —long leaders in the chemical and petroleum industries—are widely recognized as the most accurate, dependable and stable Analyzers available. They are ideal for combustion applications!

And Arnold O. Beckman Sampling Systems and accessory equipment have been carefully engineered to meet the most difficult requirements of the power industry. They are unusually simple, free of maintenance, and are readily adaptable to a wide range of operating arrangements!

To obtain helpful details on this advanced equipment for boosting profits and cutting costs through greater fuel savings and reduced maintenance, send for these free bulletins . . .

BULLETIN 108: *Describes the Model F-3 Beckman Oxygen Analyzer —the instrument designed primarily for industrial applications such as combustion control, catalyst regeneration, sulfur grinding, etc., which requires an oxygen measuring range of 0-5%, 0-10%, 0-15% or higher. Bulletin 108 describes the unique magnetic operating principle used in Model F-3 Analyzers, gives equipment specifications and typical applications.*

BULLETIN AD607: *Contains helpful charts and data on most efficient methods of controlling various combustion processes.*

BULLETIN AD608: *Outlines savings to be made with oxygen control in Cat Cracking operations, gives sampling suggestions and list of equipment.*

BULLETIN AD611: *Contains helpful data on Tunnel Kiln Applications, shows typical installation, details equipment required.*

BULLETIN AD703: *Describes a Gas Sampling System particularly suited for combustion applications in various types of plants . . . illustrates layout of equipment, provides table for selecting sample tubes.*

Arnold O. Beckman Oxygen Analyzers — industry's great new profit builders — are adaptable to all types of combustion processes. For specific application suggestions, send us details on your particular operating methods and requirements.

Arnold O. Beckman INC
1020 Mission St., South Pasadena 21, California

Please send Bulletins checked below:

☐ 108 ☐ 607 ☐ 608 ☐ 611 ☐ 703

Name _____

Company and Address _____

_____

_____

Position _____

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A graduate of Massachusetts Institute of Technology in 1930, he had been 15 years with Consolidated Edison Co. of New York and served three years with the Navy amphibious forces. He joined AGE in May, 1948, as assistant to the operating vice president of the service corporation.

He was appointed assistant to the general manager of Ohio Power Company in April, 1949, and assistant general manager 21 months later. He was named commercial vice president of the service corporation last October. A member of the American Society of Mechanical Engineers and the general committee of E. E. I., he was a director of both the service corporation and Ohio Power.

James H. King

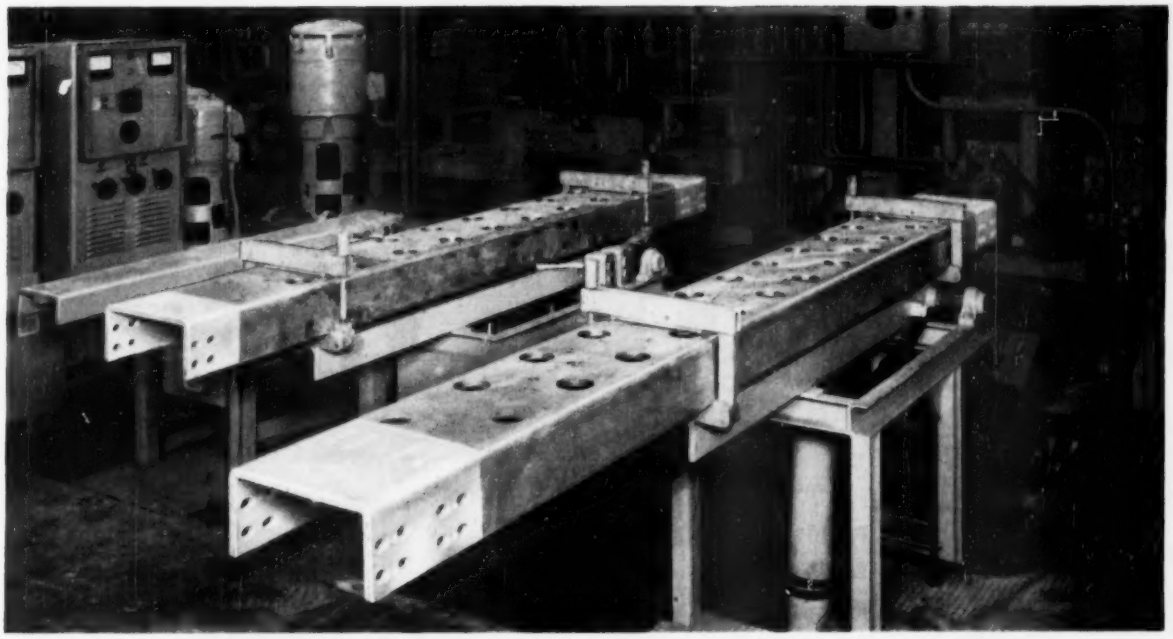
JAMES H. KING of Scarsdale, vice president and director of The Babcock & Wilcox Company of New York, died recently at the New Rochelle (N. Y.) Hospital. He was 61 years old.

Mr. King was born in New Haven, Connecticut, attended public schools

in New York and was graduated from Yale University in 1913. He joined The Babcock & Wilcox Company in 1914 as a student engineer and was assigned to the Marine department in 1917.

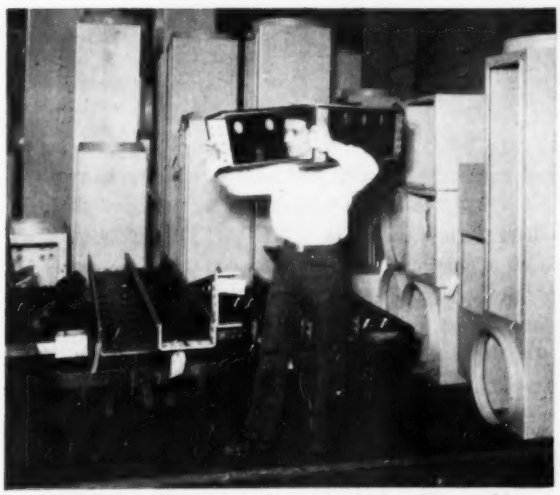
He rose to assistant manager of the Marine department in 1928 and was appointed manager of the department in 1931. He was elected a vice president of the company in 1945 and was named head of the Boiler Division in January 1952. He was elected a director of the company in April 1953. He also served as a director of the Diamond Power Specialty Company of Lancaster, Ohio and the Hooper Holmes Bureau, Inc. of New York.

Mr. King was the author of various papers on "Marine Boilers" and "Marine Propulsion Machinery." He was a member of a number of technical societies including the Society of Naval Architects and Marine Engineers in which he served as president in 1951 and 1952; the Institute of Marine Engineers; American Society of Naval Engineers; Propeller Club of United States; American Bureau of Shipping; Newcomen Society; and the Engineers Joint Council.



SILVER-PLATED CONTACT SURFACES on treated aluminum channel conductors. Special equipment (in background) enabled G-E chemists and engineers to perfect speedier automatic process for better quality control.

SILVER-PLATING BY A NEW G-E METHOD ASSURES TOP QUALITY ISOLATED-PHASE BUS



LIGHTWEIGHT ALUMINUM conductors make handling and installation easier. These sections of 8000-ampere bus are easily handled by one man as they leave silver-plating process.

Process improves electrical joints between aluminum conductor sections

An exclusive process for silver-plating aluminum—developed at General Electric's Switchgear Product Laboratory in Philadelphia—has greatly improved use of aluminum as an electrical conductor. Installation of the new, light-weight conductors can now be handled in the field in the same manner as the installation of copper conductors.

Heart of the new method, as perfected by G.E.'s engineers and chemists, consists of avoiding entrapment of alkali in the zinc deposit on the aluminum, thus giving a closer bond between the two metals . . . one that will not deteriorate with time or temperature. Previous methods left a residual coating of alkali under the silver which formed blisters and caused marked deterioration.

Use of the new channel conductors with silver-plated contacts reduces weight of isolated-phase buses by 20%. Moreover, the use of aluminum permits engineering flexibility in the design of buses, depending upon availability of materials. General Electric Company, Schenectady 5, N. Y. 873-2

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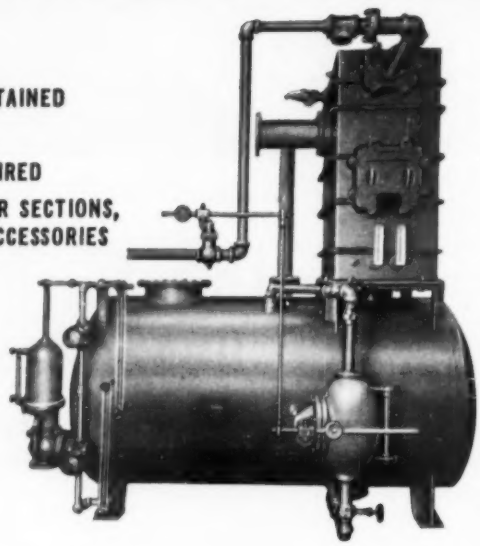
- GUARANTEED ZERO OXYGEN



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Now for the first time you can get a ready-to-install deaerator that will give you high quality boiler feedwater at extremely low cost. The UNI-PAC DEAERATOR is guaranteed to deliver water with an oxygen content not to exceed 0.005 c.c. per litre (less than 7 p.p. billion)—generally recognized as zero oxygen!

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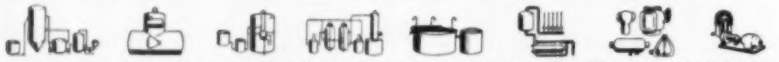

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NEW ENGINEERING BOOKS

Fluid Flow in Pipes, by Clifford H. McClain; 123 pages, size 6 by 8 ins., cloth binding. Published by The Industrial Press, 148 Lafayette St., New York 13, N. Y. Price $3.00.

This book explains in simple language the fundamental processes involved in the flow of liquids and gases through pipes and ducts, and shows in detail the derivation and uses of all formulas.

Anyone with a knowledge of elementary algebra can follow the practical working methods and formulas, it is claimed, while the advanced student will find the underlying principles fully and clearly developed.

The book emphasizes theory and practice of fluid flow from a dimensional standpoint, and shows the importance of maintaining consistent expression of dimensional relationships in solving problems.

Conditions of turbulence and streamline flow as they affect problems in friction and energy balance are discussed. Empirical formulas used in flow calculations are presented, with a discussion of the physical basis of such formulas. Applications of the principles to problems in piping are presented for would-be students together with worked-out examples.

★ ★ ★

Past Exams for Professional Engineer — New York State — 1953 Edition, compiled by John D. Constance; 50 pages, size 8½ x 11 in., planographed, separate sheets. Published by John D. Constance, Professional Engineer, 625 Hudson Terrace, Cliffside Park, New Jersey. Price $1.50.

This is a compilation of past examinations of the University of the State of New York given for the Professional Engineering license in that state. The complete examinations from January 1943 through June 1953, a total of 21 examinations, is given on these sheets.

Their value to all engineers everywhere in preparing for the Professional Engineer's license examination is obvious. This compilation shows the nature and form of the examination and is so comprehensive in its scope that it is being used by hundreds of engineers throughout the United States in preparing for the examinations.

These examination questions cover all three parts as follows:

Part 1. Structural Planning and Design.

Part 2. Practical Application of the Basic Engineering Sciences. (Hydraulics, thermodynamics, machine design, electricity)

Part 3. Engineering Economics and Practice, Chemical Engineering, Civil Engineering, Electrical Engineering and Mechanical Engineering.

The author has specialized for a number of years in the professionalizing of engineers and helping them in getting licenses. He has worked with large manufacturing companies

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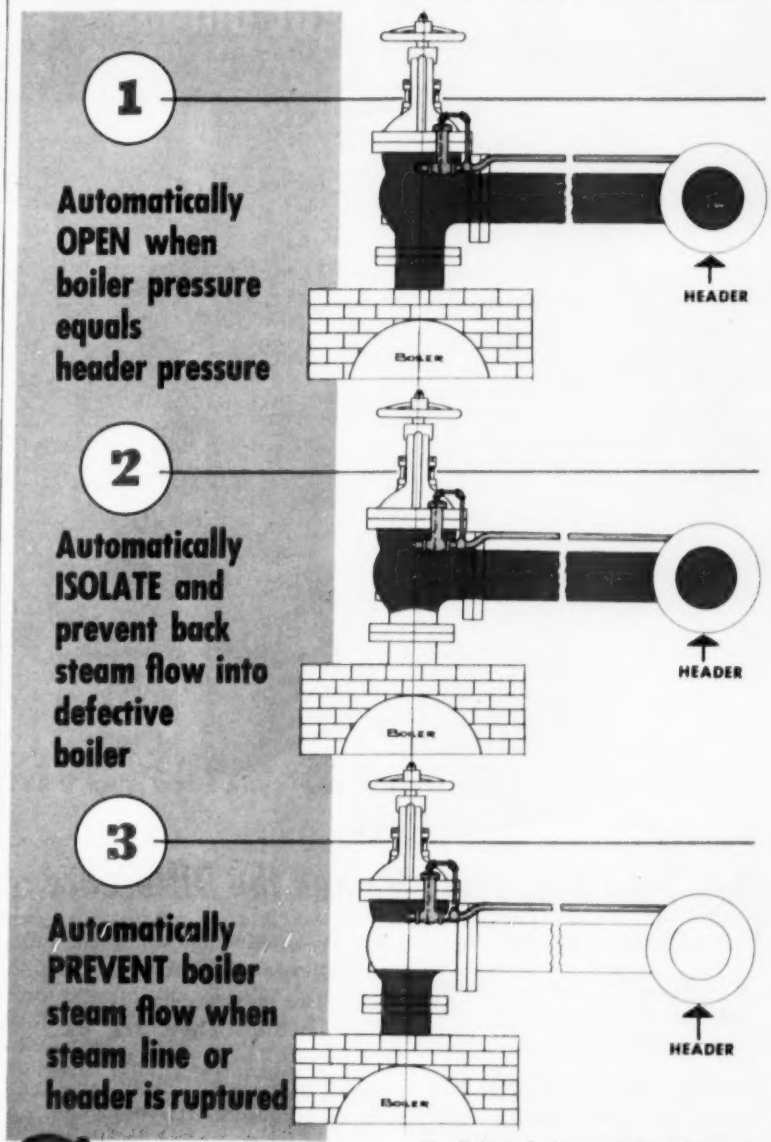
1
Automatically OPEN when boiler pressure equals header pressure
HEADER
2
Automatically ISOLATE and prevent back steam flow into defective boiler
HEADER
3
Automatically PREVENT boiler steam flow when steam line or header is ruptured
HEADER

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and educational institutions, has published various types of Refresher Notes for these examinations and is now devoting most of his time to this work, as explained in previous articles in this magazine that he has written about licensing.

★ ★ ★

Your Vibrotest; 50 pp illustrated; size 5 in. by 7 in.; paper binding; published by Associated Research Inc., 3758 West Belmont Ave., Chicago 18, Ill. Price $.50.

Here is a new 50-page insulation resistance testing manual designed around the use of Vibrotest insulation resistance testing instruments. The manual covers the entire field of insulation resistance testing in a plain language, how-to-do-it style. Directions are given for testing many specific types of electrical equipment and systems. Value of continuous record-keeping is discussed.

A free copy of the manual will be sent to all owners of Vibrotest instruments who request it from the manufacturer, giving the model and serial number of the instrument. All other interested persons may obtain copies for $.50 each.

★ ★ ★

Fun with Mathematics, by Jerome S. Meyer; size 9¼ by 6 in.; 176 pp; illustrated; 1952 edition; cloth bound. Published by the World Publishing Co., 2231 West 110th St., Cleveland, Ohio. Price $2.75.

An interesting and readable treatment of mathematics has been prepared in this book. It covers some of the fine points of mathematics as well as a number of mathematical tricks and fallacies. The book is not only educational but entertaining.

One section is given to the mechanics of nomographs which are in themselves helpful tools for making mathematical short cuts. Another portion concerns itself with the making of a slide rule from an ordinary ruler. In contrast to the decimal system that we use, the author explains and shows some interesting examples using the binary system.

Infinity, mathematical midgets, how did the Romans multiply and divide?, magic multiplication square, e and logarithms, the circle, casting out nines, and Bibonacci numbers are some topics of discussion in this book.

★ ★ ★

Opportunities in Electrical Engineering, by S. Paul Shackleton; 128 pp; size 6 by 9 in.; paper binding; published by Vocational Guidance Manuals Inc., 45 West 45th Street, New York 36, N. Y. Price $1.00.

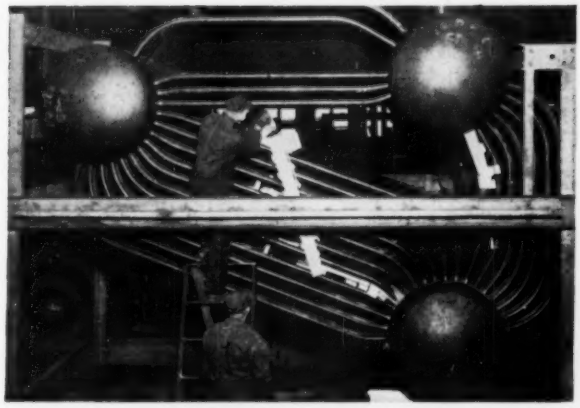
This book is an addition to the series of vocational guidance manuals published by this company. It is designed to aid young people in the intelligent selection of a career.

The book opens with a reproduction of the famous declaration, Faith of the Engineer, originally published by the Engineers' Council for Professional Development.

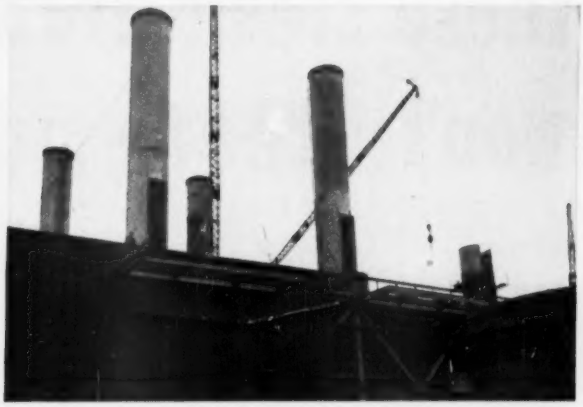
The various chapters of the book cover the scope of electrical engineering, the field of electrical engineering, qualifications, edu-

continued on page 125

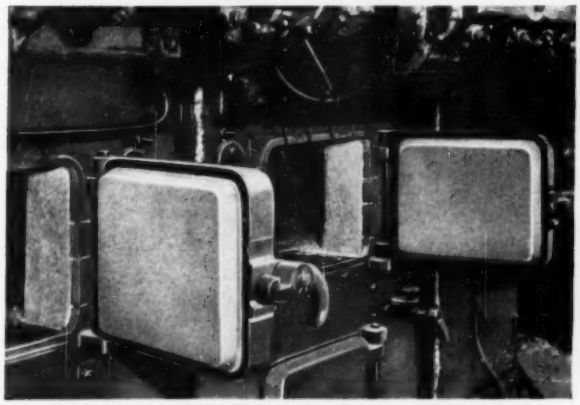
IN POWER PLANTS ON JOBS LIKE THESE:



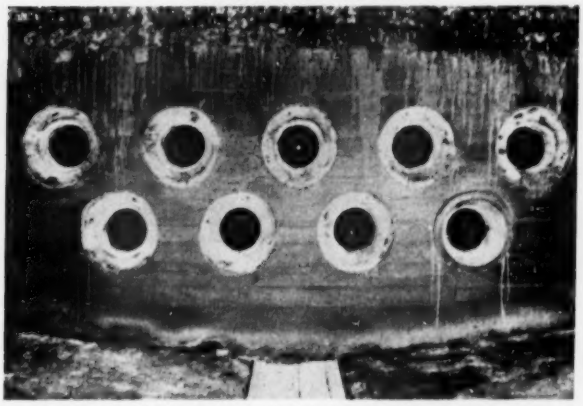
Monolithic gas-tight baffles of Refractory Concrete are easily made with a castable refractory and simple forms.



Lumnite steel stack linings keep drafts up and costly repairs due to corrosion and abrasion down.



Door linings and other special shapes are easily cast in molds with adaptable Castable Refractory Concrete.



Front wall of boiler is lined with 9 inches of Refractory Concrete—section in excellent condition after a year of service.

Castables save time and cut costs

Power-plant engineers find that castable refractories provide a fast, easy way to place or repair linings in steel stacks, breechings, boiler walls and hearths, doors, coal bunkers and ash pits. Refractory and insulating concrete made with castables can be mixed simply by adding water right on the job, and casting into place. Costs are cut and time saved because they reach service strength within 24 hours—and usually give better service than other refractories.

Castables are prepared mixes of Lumnite* calcium-aluminate cement and special aggregates selected to meet specific temperature and insulation service. They are made by manufacturers of refractories, sold through their dealers, and come ready-made for many refractory jobs.

There is no need to stock large inventories of special refractory shapes—they can be cast as needed. Keep a supply of your favorite brand of Lumnite castable on hand ready for a rush job. For more information write: Lumnite Division, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, New York.

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COAL, ASH HANDLING

201 Economic Coal Storage — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination offers plus benefits. Illustrated with action photos; pictures several models. Tractor Div., Allis-Chalmers Mfg. Co.

202 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

203 Spreader Stoker — Sixteen-pp Bulletin 800 describes manufacturer's Type C-C RotoStoker, a relatively small spreader stoker offering continuous cleaning and ash discharge advantages of larger units, without need of a basement for ash removal. Explains this and other operational advantages of the stoker, which is adapted to modern steam boilers with output capacities of about 5000 to 75,000 lb of steam per hour. Detroit Stoker Co.

204 Spreader Stoker Selection — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

205 Automatic Coal Scale — Sixteen-pp Bulletin 0352 describes an automatic coal scale for weighing coal as it is fed to boilers, enabling a power engineer to maintain a constant check on boiler efficiency. Book gives construction and operating details on the belt feeder, weigh hopper, scale housing, operating levers and accessories. Photos and line drawings show scale features. Richardson Scale Co.

206 Why Liquid Diffusion — What liquid diffusion can do for power plants is explained in Form B, which tells how liquid diffusion compounds work and gives four practical applications. These include dust control in coal handling, fly-ash control, coal storage pile treatment and boiler cleaning. Johnson-March.

207 Shredder Ring Crusher — A crusher for coal and similar materials which features rolling shredder rings is described in this 8-pp bulletin. Gives details on a survey of 29 mines and power plants in which this type crusher is installed. Informative tables giving speed, capacity, horsepower, weight and dimensions of crushers, as well as cost data are included. American Pulverizer Co.

208 Ash Handling Systems — This 24-pp booklet offers technical information on hydraulic and pneumatic ash and fly-ash

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handling systems. Compiled in question and answer form. Discusses elements and advantages of various systems and disposal schemes. Schematic drawings of arrangements under specific conditions are included. Beaumont Birch Co.

209 Fly Ash Elimination — This 30-pp booklet presents manufacturer's "Multiclone" equipment (described as small-tube type of cyclonic dust collectors using centrifugal force for separating dust from gas stream) as a highly successful and economical means of separating fly ash — not as a panacea for all cinder and fly ash problems. Also gives data on single and double hopper installations. Western Precipitation Corp.

FUEL OILS, LUBRICANTS

210 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, also safety precautions. Cities Service Petroleum, Inc.

211 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is covered. Sinclair Refining Co.

212 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

213 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations, photos of purifiers. DeLaval Separator Co.

214 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel oils, dust control. Gulf Oil Corp., Gulf Refining Co.

215 Lubricants, Fittings and Methods — Bulletin V-220, 12 pp, describes three major types of lubricants. A selection chart indicates specific lubricants for a large number of chemicals. A special feature of the bulletin is an illustrated outline of the three functions of a lubricant in the company's valves. The new combination button head fitting and lubricant screw is illustrated along with bucket pump, gun and gun accessories. Also includes servicing tips. Rockwell Mfg. Co.

216 Lubrication of Chain Drives — Vol. 39, No. 8 of Lubrication offers

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a 10-pp discussion on chain drives and their lubrication. Covers types of chains, conditions affecting their lubrication, choice of lubricants. Includes table showing lubricant recommendations for chain drives. Generously illustrated with photos and sketches showing chain arrangements, methods of lubrication. The Texas Co.

217 Petroleum Pitch — This illustrated article on petroleum pitch as a boiler fuel stresses its low cost, other advantages. Explains combustion of pitch; discusses unloading method, burning, storage, fuel oil treatment, also precautions in handling hot pitch. Kor Corp.

GAS AND OIL BURNERS

218 Gas Burners — Illustrated Bulletin 410-8, 16 pp, furnishes descriptive and technical data on company's gas burners and combination gas and oil burners, giving design details and explaining operation of each. Coppus Engineering Corp.

219 Oil Burning Equipment — Bulletin O-B 37 contains 16 pp of technical information on company's oil and gas burning equipment, steam atomizing burners, mechanical atomizing burners, interchangeable burners, telling best applications, including capacity data. Also shows heating systems. The Engineer Co.

220 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. National Airoil Burner Co., Inc.

BOILERS, GENERATORS

221 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions and standard and accessory equipment for the units which range from 20 to 6000 hp, for pressures to 250 psi. Preferred Utilities Mfg. Corp.

222 Shop-Assembled Boiler — Sixteen-pp Bulletin G-76, completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. Savings in erection, installation and moving costs are stressed. Capacities, dimensions given. The Babcock & Wilcox Co.

223 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cut-away illustration shows design details, and gas travel. Use of generator with various fuels and firing arrangements is covered. Erie City Iron Works.

224 Steam Boilers — Form SG 128-749 is a 12 pp catalog illustrated with photos of steam boilers for processing and heating, ranging from 15 to 500 hp and 15 to 200 psi. Includes diagrammatic cross-section of four-pass design characteristic of company's boilers. Cleaver-Brooks Co.

225 Packaged Boilers — This 16-pp illustrated catalog describes manufactur-

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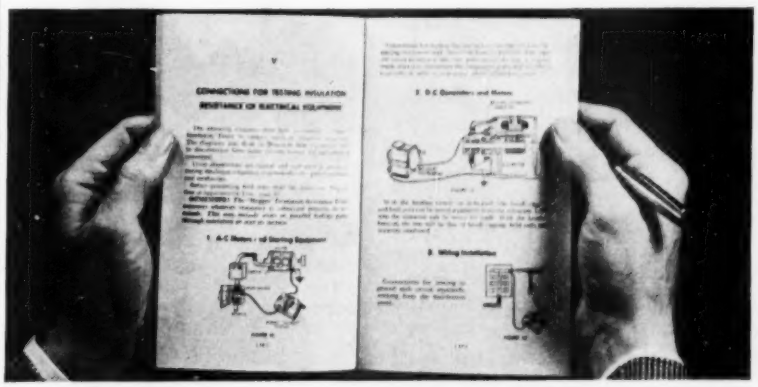

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Fig. 4001/6561. Duplex unit consisting of Straightway Lever-operated Valve and Angle Valve.

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Fig. 6571/6561. Duplex unit consisting of Y Valve and Angle Valve.

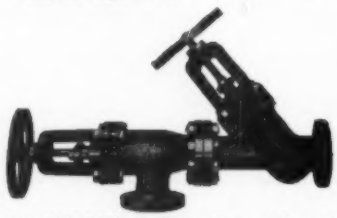

Fig. 6561/6371. Duplex unit consisting of Angle Valve and Y Valve.

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er's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

226 Water-Tube Package Boilers — This bulletin describes and illustrates company's Type H water tube package units. Advantages of the boiler are listed. Also included are dimension drawings and a table of capacities, sizes and weights for ten standard sizes from 8000 to 30,000 lb of steam per hour. The Bigelow Co.

REFRACTORIES, INSULATION

227 Refractories for Heat, Power — Compiled to help power engineers solve refractory problems and get greater operating efficiency from their boilers, this booklet provides 32 pp of practical information on company's Crystolon refractories. Properties and characteristics of these silicon carbide products are given and separate chapters cover those for air-cooled, solid wall and water tube protection, and for laying brick and repairs. Suggested uses in various types of boilers are illustrated. Norton Co.

228 Insulating Material — Ultrafine, a thermal and acoustical insulation made of blown glass fibers, is presented in this bulletin. Shows it in use; gives data on properties, thermal conductivity. Gustin-Bacon Mfg. Co.

229 Heat Insulation Data — This is a 12-pp illustrated engineering and specification manual describing applications for 85 per cent Magnesia heat insulation. Provides data on heat savings per pipe thickness, for heat ranges to 600 F. Includes charts for determining thickness standards for pipe covering, with tables for heat calculations. Mundet Cork Corp

TUBING AND ACCESSORIES

230 Condenser Tubes — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Details on proper installation are presented, as are specifications, conversion tables, and weights. Scovill Mfg. Co.

231 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

232 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

233 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents

tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators. Discusses heat transfer properties, high temperature use. Bridgeport Brass Co.

234 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Electrically driven equipment, air valves, hose, lubricators presented. Thomas C. Wilson, Inc.

235 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads discussing special features. Roto Div., Elliott Co.

236 Data on Stress Values — Data Card 154 is designed to help power engineers concerned with the operation of tubular equipment at elevated temperatures and pressures. The card is an adaptation of Table P-7 of the new ASME Boiler Code and is complete with notes and formulas for calculating maximum allowable working pressures. Tubular Products Division, The Babcock & Wilcox Co.

VALVES, TRAPS, PIPING AND ACCESSORIES

237 Safety Valve Engineering Data — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, also provides tables on superheat correction factor. Manning, Maxwell & Moore, Inc.

238 Valve Specialties — Included in 90-pp Catalog A-50 is ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas, water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves; pilot valves; back pressure, relief and non-return valves, steam trap and air vent; liquid level controllers; solenoid valves. Davis Regulator Co.

239 For Quick Valve Selection — Here's a 20-pp catalog digest providing ordering and application information on gate, globe, angle and check valves in bronze, iron, cast and forged steel construction, also valve accessories and parts. Illustrated and indexed, includes pressure-temperature chart. The Ohio Injector Co.

240 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

241 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

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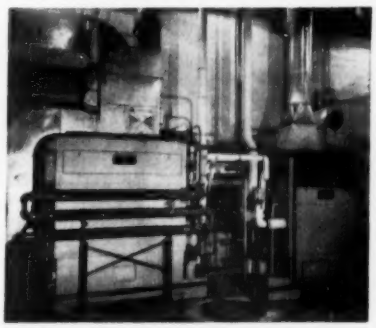

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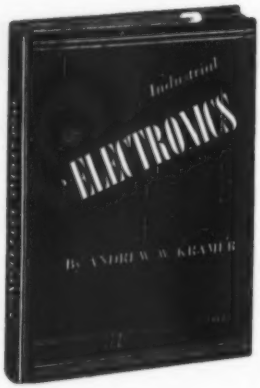

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242 Cast Steel Valves — This 56-pp. catalog on cast steel valves includes information on globe, angle and check valves in 300, 600, 900 and 1500 lb pressure classes. Parabolic disc valves for hand or motor control of volume are also described. In addition to standard information on construction features, dimensions and weights, the booklet contains complete data on material specifications, preparation of welding ends, flange facings, and ratings. Edward Valves, Inc.

243 Lubricated Plug Valves — Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows accessories. The William Powell Co.

244 Pressure Reducing Valve — Bulletin 228, 8 pp, describes and pictures a pilot-operated pressure reducing valve designed for automatic control of reduced pressure required in steam service. Gives advantages of the valve, illustrates method of installation. McAlear Mfg. Co.

245 Easily Operated Valve — Bulletin W-8 describes design and construction of company's Flowtrol suggested as a replacement for gate valves that require frequent manual opening and closing, or in place of diaphragm valves. Stresses air and water cushioning to prevent hammer or shock, easy installation, other features. Golden-Anderson Valve Specialty Co.

Postage-free cards for ordering these catalogs are provided on pages 113-114. When using them, don't forget to include your job title and company name—even if you want your catalogs to be delivered to your home address

246 For Precise Control — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manuals and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages are discussed. R. S. Valve Div., S. Morgan Smith Co.

247 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

248 Handbook on Fittings, Flanges — Catalog wf-1950, 68 pp, offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

249 Improved Pipe Hanger — Twelve-pp Bulletin 153 describes company's Counterpoise pipe hanger for high temperature piping systems in steam generating stations, refineries and chemical

plants. Tells how it offers efficient load supporting effort of constant value throughout entire range of travel as pipe expands or contracts because of temperature changes. Graphs for selecting proper hangers, tables of dimensions, plus erection are given. National Valve & Mfg. Co.

250 Data on Strainers — Several types of pipe line strainers for all purposes in sizes from ½ to 36 in. are described and illustrated in 16-pp Manual 951. Summarizing important developments, booklet carries information on factors to consider in selecting a strainer for a specific application. J. A. Zurn Mfg. Co.

251 Solving Steam Trap Problems — This 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves; submerged surfaces, steam mains and header drips. Gives pointers on how to install and service traps. The V. D. Anderson Co.

252 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

253 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Yarnall-Waring Co.

254 Industrial Steam Traps — Twelve-pp Bulletin 853 describes steam traps with bellows of bronze, Monel or stainless steel, and bodies in bronze, semi-steel and cast steel construction in sizes ¼ to 2 in., for pressures from vacuum to 300 lb. Included besides capacity tables and dimensions are piping diagrams, typical applications, and data covering the selection. W. H. Nicholson & Co.

255 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8-pp valve selection guide. Crane Co.

PUMPS, PUMPING

256 Condensed Pump Data — Form 4383-J covers more than 20 types of general service pumps, rotary pumps, sump and drainage pumps, condensate units, self-priming units, stainless steel pumps and high pressure pumps. In easy-to-find tabular form, each model is pictured along with its characteristics, applications, features and references to specific literature. Goulds Pumps, Inc.

257 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure,

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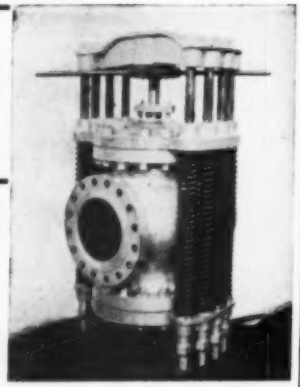

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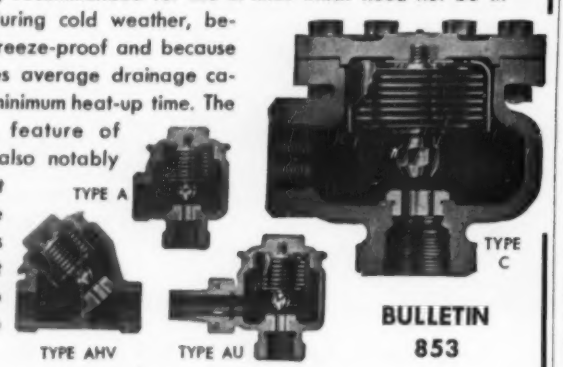

BULLETIN 853

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high temperature service and designed to go on the line quickly without preliminary warm-up, is the subject of 12-pp. Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. De Laval Steam Turbine Co.

259 Gear Pumps — Besides presenting all of company's standard gear pumps, 24-pp Bulletin 17-A describes briefly some special types engineered for unusual requirements. Discusses design, construction and operation of the pumps; tells how they're used in the power and industrial fields. Drawings, action photos, capacity and pressure tables and performance data supplement the text. Booklet covers pumps ranging from 1 gph to 1000 gpm capacities. Schutte and Koerting Co.

260 Controlled Volume Pumps — Motor-driven controlled volume pumps are fully described in 40-pp Bulletin 553. Provides information on design and construction of the pumps, and includes capacity-pressure selection tables, types of capacity adjustments, standard and special designs and packaged systems. A chart shows typical applications in six major industries, and another chart, in full color, shows construction materials suited for use with some 170 industrial fluids. Milton Roy Co.

HEAT EXCHANGING, COOLING

261 Heat Exchangers — The advantages of film-type heat exchangers n the solution of cooling water problems, even when dirty water must be used, are stressed in Bulletin HE-7, 8 pp. Explains and illustrates design details. Discusses use of these heat exchangers in power plants, chemical plants, and in a compression plant. Henry Vogt Machine Co.

262 Finned Tube Heat Exchanger — Bulletin 1400, 20 pp, fully describes the company's G-R Twin G-Fin Section heat exchanger. The unit has wide application for heating and cooling liquids and gases, and for condensing vapors, according to the company. Suitable as boiler feedwater preheaters, fuel oil heaters, etc., features of design and construction are given. Griscom-Russell Co.

263 Heat Exchanger — Bulletin 114, a small folder, gives concise information on company's Aero heat exchanger with balanced wet bulb control designed to cool engines or process equipment, coolants and lubricants, liquids and gases for processing operations. Niagara Blower Co.

ELECTRICAL

265 Electrical Maintenance Tips — Booklet B-5477, 28 pp, gives a complete outline of preventive electrical maintenance. Discusses general maintenance programs designed to reduce shutdown time and treats in detail the maintenance of power equipment. A suggested schedule of work and cleaning on power equipment is presented in chart form. Essential information on preventive maintenance for turbines, generators, switchboards, motors and controls is provided. Westinghouse Electric Corp.

266 Wire, Cable Ordering Guide — Newly-released General Catalog W-52-3, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords.

A technical engineering data section is included. Available to qualified power engineers. United States Rubber Co.

267 Power Distribution Practices — The 28-pp "Industrial Power Distribution Idea Book" (Bulletin GEA 5900) is a guide on electric power distribution practices in large and small plants. Covers utility distribution practices; methods of buying electric power; what to do when a choice of primary voltages is available; application of primary switches and circuit breakers; types and arrangements of primary cables; and types of load-center distribution systems. General Electric Co.

268 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control, general characteristics and representative dimensions. Allis-Chalmers Mfg. Co.

269 Insulation Temperature-Resistance — Technical Publication 21T4, 16 pp, is an article on temperature-resistance characteristics of electrical insulation. Complete with tables and graphs, gives general information on variations in temperature characteristics, composite nature of electrical insulation, and practicability of temperature compensation. Other chapters deal with determining insulation constants for temperature correction factors, dielectric absorption characteristics, and a practical method of obtaining insulation temperature. James G. Biddle Co.

INSTRUMENTS AND CONTROLS

270 Supervisory Instruments — Catalog 90-2. "Supervisory Instruments for Power Generation," consists of 41 pp on the instrumentation involved in generating stations. Separate sections cover steam generation instrumentation, turbine and generator instrumentation, electrical distribution instrumentation and diesel engine instrumentation. Measurement of temperature, pressure, flow, power generation and other variables discussed. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

271 Instruments Control Systems — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls. Republic Flow Meters Co.

272 Control Centers — This 31-pp application booklet (B-5621) on control centers stresses the case for centralizing all controls of an entire system in one group of enclosures. Discusses the characteristics of control centers that make for flexibility of use, ease of servicing, safety. Three types are described, and the various electrical components that make up typical units are illustrated. A three-step building-block system of planning control centers is given. Westinghouse Electric Corp.

273 Control Equipment — Catalog 003, 32 pp, presents company's equipment for the control of liquids and gases for water and sewage works, power and process industries. A well illustrated booklet, it lists many types of controllers, gages, manometers, valves, venturi tubes. Description of the units, their operating characteristics, construction details, mountings, specifications and other data included. Simplex Valve & Meter Co.

274 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, and detailed literature references included. Bailey Meter Co.

275 How to Select Regulators — This 36-pp, illustrated "step selection chart" simplifies choice of proper type and size of pressure regulator, temperature regulator or pump governor to do a specific job. Written in nontechnical language and supplemented by steam, gas and water capacity tables, this booklet includes installation suggestions, conversion tables and other data. Foster Engineering Co.

276 Steam Specialties — Catalog 53, 62 pp, describes a line of steam, gas, air, oil and water regulating equipment. Includes complete specifications, operational data and prices on pressure regulators, temperature regulators, combination pressure-temperature, instruments, diaphragm valves, motor operated valves, float valves, safety and relief valves, strainers, solenoid and motor valves, water gages. Provides capacity tables, flange charts. O. C. Keckley Co.

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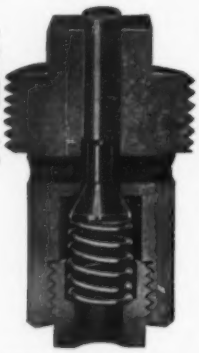

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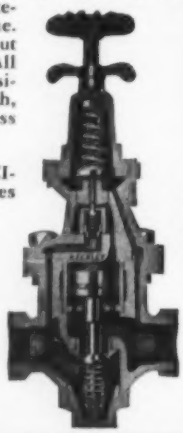

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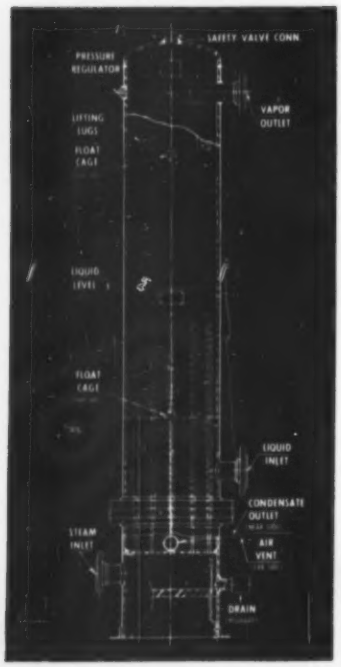

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277 For Feedwater Analysis — Bulletin 148 BP contains a technical discussion of manufacturer's analyzers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both O_2 and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

278 Electronic Feedwater Control — Three systems for the electronic regulation of boiler feedwater are explained briefly and diagrammed in Bulletin 52-1073-221. They include a single-element, two-element, and three-element system. Applications for each type are told, and descriptions of the flow measuring, receiving, level measuring elements, power unit and valve are included. The Hays Corp.

279 Boiler Control — Ten-pp Bulletin 1007 describes a completely integrated system for controlling combustion, feedwater, boiler steam temperature and boiler cleaning, available in a single package or furnished separately. Illustrated with full color drawing of complete control, photos of recorders, drive unit. Covers instrumentation with both miniature and standard instruments. Copes-Vulcan Div., Continental Foundry & Machine Co.

280 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

PACKINGS, GASKETS, SEALS

281 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for a wide variety of applications. Packing Div., Raybestos-Manhattan, Inc.

282 Seals for Bearings — Complete information on manufacturer's Klozure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co.

283 Packings for the Power Plant — Designed as a quick-reference aid, one feature of this compact 6-pp guide is a flow sheet of a rudimentary industrial power plant with each unit keyed to the proper packings and gaskets. Illustrated. Includes construction information, sizes. Johns-Manville.

284 Long Wearing Piston Packing — Form 4502, 8 pp, presents composition cups for packing pistons of air and hydraulic cylinders and reciprocating pumps. Engineering information covers properties, textures, temperature and pressure data, sizes. Darling Valve & Mfg. Co.

WATER CONDITIONING

285 What's What on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Phys-

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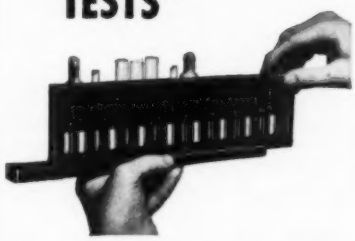

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ical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp.

286 Modern pH and Chlorine Control — This 100-pp booklet gives details in color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; feedwater. W. A. Taylor & Co.

287 Water Conditioning Data Book — Recently revised, this pocket-size 116-pp booklet presents a compilation of 77 tables, all valuable to the power engineer. Covers such subjects as hydraulics, impurities in water, boiler feedwater makeup requirements, chemical conversions and chemical reactions. Contains excellent reference information on many phases and methods of water treatment. Available without charge to qualified power engineers. The Permutit Co.

288 Data on Zeolite Softeners — Publication 4520-A is a 32-pp well illustrated booklet on zeolite water softening. Provides a glossary of terms used in the process, data for laying out a zeolite softening plant, factors governing size of equipment, selection of zeolite materials and discussion of the operating stages of a sodium zeolite softener. Cochrane Corp.

289 Mixed-Bed Demineralization — Bulletin 126 explains in text and pictures how a mixed-bed demineralizer operates in producing high-purity water by ion-exchange method. Stresses company's simplified positive regeneration system which separates resins quickly and remixes them. Barnstead Still & Sterilizer Co.

291 Ion Exchange Softening — Eight-pp illustrated Form S-105 provides information needed for accurate specification of water softener equipment for industrial plants and institutions where hardness-free water is required or desired. Gives data on valves, as well as chart-type specifications on many sizes of softener units. Illinois Water Treatment Co.

292 Boiler Scale — Formation and Prevention — Technical Paper 98 is a 12-pp article covering the cause and prevention of boiler scale. Covers the mechanism of scale formation, effect of boiler scale, chemistry of scale formation, internal chemical treatment and chemical correctives. Diagrams of feeder systems, photos and solubility charts illustrate text. W. H. & L. D. Betz.

293 Boiler Water Manual — Factual information on methods of applying chemicals in treatment of water for boilers is presented in 16-pp Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and feedwater system, condensate returns. % Proportioneers, Inc. %

294 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

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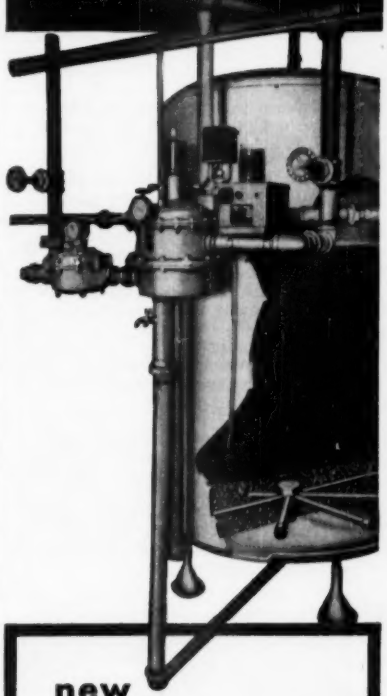

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295 Microbiological Control — Technical Article 3C, 12 pp, is an illustrated discussion of microbiological control of and through industrial waters. A section on industrial water chlorination covers cooling waters and process waters. Other sections deal with chlorine metering in chemical processes, and the sanitary aspects. Wallace & Tiernan Co., Inc.

OTHER EQUIPMENT

296 Burning Bituminous Coal — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

297 New Engine Developments — Bulletin S-500-B-55, 12 pp, presents new developments in oil diesel, dual fuel diesel and high compression spark ignition engines. Describes features of modern, economical, heavy duty, internal combustion engines. Includes a heat balance chart showing waste heat recoverable from exhaust gases and jacket cooling water; and is accompanied by fuel cost charts and descriptions of installations utilizing heat recovery systems. Engine Div., Worthington Corp.

298 Turbine Generators — Bulletin H-18, 40 pp, covers turbine generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings. Elliott Co.

299 Motorized Chimney Draft — The advantages of mechanical draft in supplying positive, uniform, adequate draft, regardless of variable weather conditions or inadequate chimney or breeching construction are shown in detail in Bulletin I-52. Also discusses other advantages, including eliminating need for tall stacks. L. J. Wing Mfg. Co.

300 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm to provide dependable operation at maximum temperatures. The Wickes Boiler Co.

301 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

302 Hydraulic Equipment — Circular 50-A, 6 pp, describes and pictures hydraulic jacks, hydraulic high-pressure and test pumps, and hydraulic units for forcing, pressing, pulling etc. Includes application suggestions, material specifications, capacities. Richard Dudgeon Inc.

Postage-free cards for ordering catalogs are on pages 113-114. You may also use the cards to ask for further information on the advertised products

303 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, removable tube bundles. Davis Engineering Corp.

304 Copper and Corrosion — Information on corrosive attack on copper and copper alloys is presented in Publication B-36R, a new 28-pp revised edition of company's booklet, "Corrosion Resistance of Copper and Copper Alloys." Explains chemical and physical nature of corrosive attack in its various forms, and provides a tabulation showing the relative corrosion resistance of the principal types of copper and copper base alloys in contact with corrosives. The American Brass Co.

305 Ejector Instruction Manual — Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Discusses twin and triple element ejectors, surface and jet inter- and after-condensers, isolating valves, drain traps, steam and back pressures. Foster Wheeler Corp.

306 Chemical Cleaning Service — Reduced maintenance costs and outage time are among advantages of company's chemical cleaning service for steam equipment and water lines discussed in this 8-pp bulletin. Before-and-after photos show some actual cleaning jobs. Dowell Inc.

307 Air Preheaters — Illustrated Bulletin A-11610, 8 pp, defines air preheat and explains its benefits in terms of increased efficiency and capacity and flame stability. Describes company's Ljungstrom preheater. The Air Preheater Corp.

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New Engineering Books

continued from page 110

cation, licensing, getting started, advancement, opportunities for employment, related fields and organizations of the field.

At the end is a bibliography of books and articles on the profession of engineering and electrical engineering in particular that the student is advised to read. This is followed by a list of accredited undergraduate engineering courses in the various colleges and universities of the country as compiled by the E.C.P.D.

The author spent many years in research work with the American Telephone and Telegraph Company and the Bell Telephone Laboratories and for the last eighteen years has been engaged in Advisory Guidance Service in the high schools of New York City and vicinity, mostly as a member of the New York Engineers Committee on student guidance. He is a licensed professional engineer in New York and New Jersey and a member of many scientific and technical societies.

★ ★ ★

American Standard Cast-Iron Screwed Drainage Fittings, ASA B16.12–1953; by Section Committee B-16; size 8½ by 11 in.; 16 pp illustrated; paper binding; published by the American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y. Price $1.00.

This authoritative publication begins by discussing marking, material, tolerance, threading, ribs and coatings, then shows diagrams and tables of dimensions of all types of cast iron screwed drainage fittings.

★ ★ ★

Steam Contamination, by Various Authors; Symposium of Five Papers; size 8½ by 11 in., illustrated; published by Research Department, American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y. Price $2.00.

Five papers on the subject of steam contamination were presented in 1951 at the Annual ASME Meeting under the sponsorship of the Joint Research Committee on Boiler Feedwater Studies. These, along with the discussions and authors' closures, have been assembled under one cover and can be obtained from the ASME. The papers review some of the latest developments and results of research work in various phases of steam contamination such as silica measurement, the solubility of silica in steam, steam sampling and the separation of steam and water in boiler drums. This symposium includes the following papers:

(1) Correlation of Silica Carry-Over and Solubility Studies (Paper No. 51-A-91), by C. Jacklin and S. R. Brower.

(2) The Spectrophotometric Determination of Small Amounts of Soluble Silica in Water (Paper No. 51-A092), by H. E. Robison, E. A. Pirsh and Elizabeth J. Grimm.

(3) Adaptation of the Spectrophotometric Determination of Small Amounts of Soluble Silica in Water to the Determination of Undissolved Forms of Silica (Paper No. 51-A-93), by H. E. Robison, Elizabeth J. Grimm and C. Brown.

(4) Field Testing of Steam Sampling Nozzles as Applied to Evaporator Vapor (Paper No. 51-A-94), by E. B. Morris.

(5) Influence of Boiler Design and Operation Conditions on Steam Contamination (Paper No. 51-A-95), by P. M. Brister, F. G. Raynor and E. A. Pirsh.

★ ★ ★

Fatigue of Metals, by Dr. R. Gazaud, translated by A. J. Fenner; size 10 by 6¾ in.; 334 pp including index; illustrated; cloth bound. Published by Philosophical Library, 15 East 40th St., New York 16, N. Y. Price $12.50.

The French author of this book is a recognized authority in the specialized field of study on metal fatigue. His work has been closely connected with a number of industries for over twenty-five years; among these are the aeronautical and automotive.

In the book, attention is given not only to failures but to methods of detection, strength improvement, testing and machines used for testing.

Among the many topics covered by the book are the following: relationships between fatigue limits and other properties of steels; stresses accompanying electrolytic deposition; influence of size and shape; effect of corrosion and chemical action;

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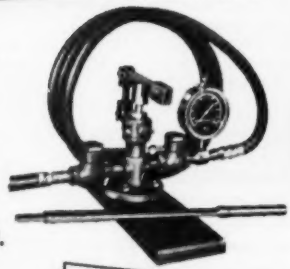

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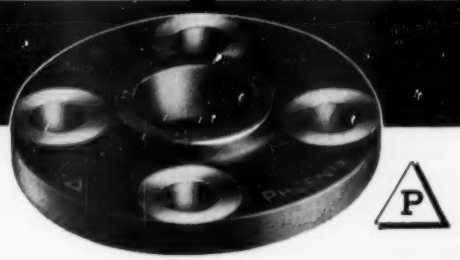

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fatigue strength of welded joints; and determination of stresses in machine parts.

This accumulation of test data and facts on metal fatigue should make it a good reference book for engineers interested in design and metals.

★ ★ ★

Betz Handbook of Industrial Water Conditioning; 250 pages, illustrated; size 8½ by 11 in.; flexible fiber binding; published by W. H. & L. D. Betz, Gillingham and Worth Streets, Philadelphia 24, Penna. Price $3, postage prepaid.

This new 4th edition of the Betz Handbook of Industrial Water Conditioning offers a practical up-to-date text for reference or study. Although it is basically a technical publication, the subject matter is presented in a direct, simple and easy-to-understand form. With this handbook, one does not need specialized knowledge of water chemistry and engineering to understand the basic problems involved and the latest developments in water technology. For this reason, we highly recommend it to power engineers, most of whom are not chemists, but need to know the fundamentals of water conditioning.

The introductory chapters of the handbook deal with basic water treatment processes such as aeration, coagulation, softening, etc. The following chapters are concerned with specific water problems, particularly problems encountered in boiler water and cooling water conditioning. Applications and limitations of various water-treating equipment and methods are covered in detail.

To guide engineers and chemists in handling and supervising water conditioning operations, a supplementary section of the handbook is devoted to control water analyses and their interpretation.

The handbook has been carefully organized for quick reference or easy study in any or all phases of industrial water conditioning. It is a valuable, time-saving "tool" — not only for engineers and chemists working directly with water problems, but also for management executives, consultants and others concerned in some degree with water conditioning in industrial plants.

★ ★ ★

Trane Refrigeration Manual; 125 pp; size 8½ by 11 in.; illustrated; spiral binding, paper cover; published by the Trane Company, LaCrosse, Wisconsin. Price $1.50.

This is a completely revised edition of the previously published manual. It gives practical, easy-to-understand information on installation, operation and servicing of refrigeration equipment and is designed especially for contractors and service men.

This latest edition contains two new chapters on refrigeration piping, embodying the latest engineering data on the subject. Other changes include a new chapter on refrigeration system control, a revised chapter on service operation and a completely revised refrigeration system service-analysis chart.

The manual begins with a discussion of refrigerants and the refrigeration cycle. This is followed by chapters giving data on the selection, installation and servicing of all the component parts of refrigeration systems, including evaporators, compressors, condensers, expansion valves, motors and control equipment, heat exchangers, driers, valves, piping and accessories.

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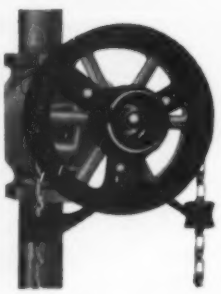

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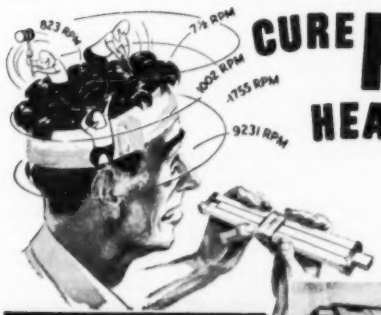

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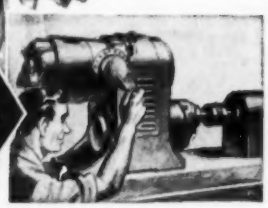

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WHEN designing a machine, avoid "rpm headaches" of fixed speed selection. Install a U. S. Varidrive Motor so that your machine can be operated at any and all speeds. *Eliminate guesswork.* Your machine speed can be instantly matched to each specific job or condition by turning a convenient control dial on the Varidrive. Increase performance by adopting the most modern of all drives—*Varidrive.*

Ask for new U.S. Varidrive Bulletin.

U.S. ELECTRICAL MOTORS Inc.

Box 2058, Los Angeles 54, Calif., or Milford, Conn.

For more data circle 518 on Post Card

3 Sure ways to LICK FEEDWATER PROBLEMS

- END SCALE FORMATION
- REDUCE BLOW-DOWN AND MAKE-UP
- CUT DOWN COSTLY BOILER REPAIRS

WITH

Barnstead

DEMINERALIZED WATER

Thousands of Power Engineers have solved their Feedwater Problems *positively* and *permanently* with Barnstead Demineralized Water.

ONLY a constant supply of high-purity demineralized water can end the expensive nuisance of scale formation ... do away with excessive blow-down and make-up ... keep your boilers trouble-free year after year.

Only Barnstead, backed by more than 75 years of *continuous* experience in solving Pure Water Problems, can offer you such a wide variety of Mixed-Bed, Two-Bed, and Four-Bed Demineralizers, ranging in capacity from 10 to 2500 gallons per hour.

Only Barnstead engineers can analyze your feedwater requirements in detail, recommend equipment *exactly suited* to your needs and provide a *positive, permanent* solution to your problem.

Write today for our engineers' recommendations. If you wish, send a one-gallon sample of your raw water for analysis. There is no charge or obligation for this service.

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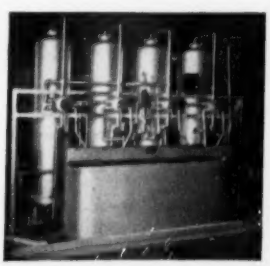

NEW! Write for NEW Barnstead Bulletin #127, a complete catalog of Barnstead Demineralizers.

Barnstead

STILL & STERILIZER CO.

41 Lanesville Terrace, Forest Hills, Boston 31, Mass.
JAmaica Plain 4-3100

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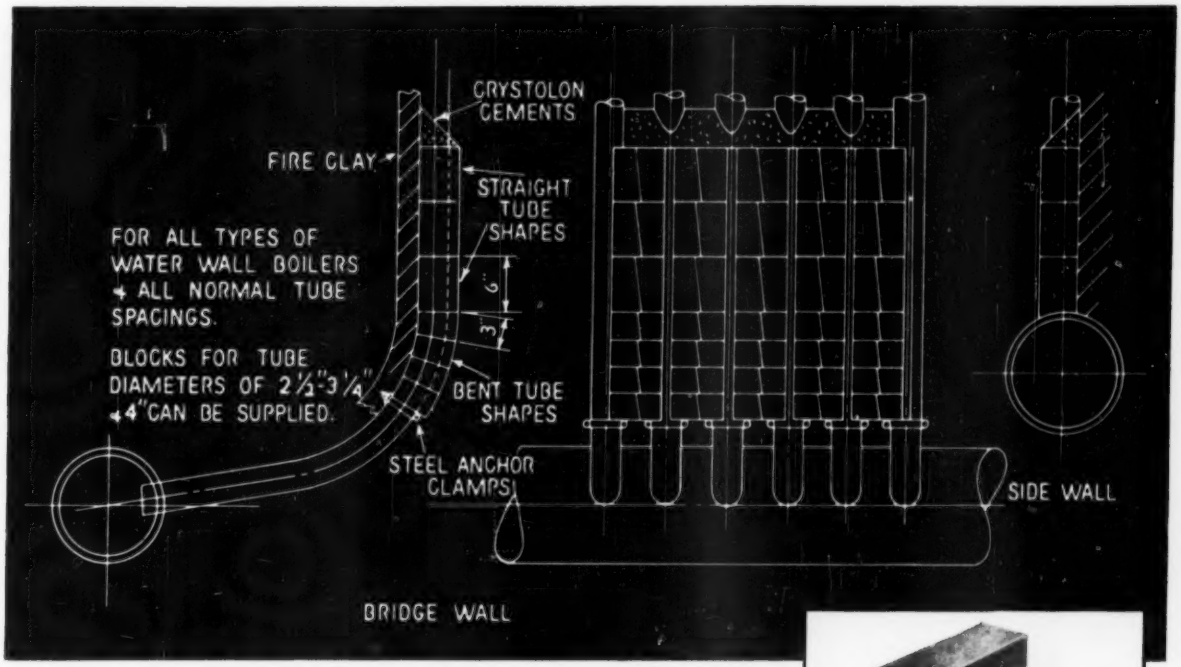
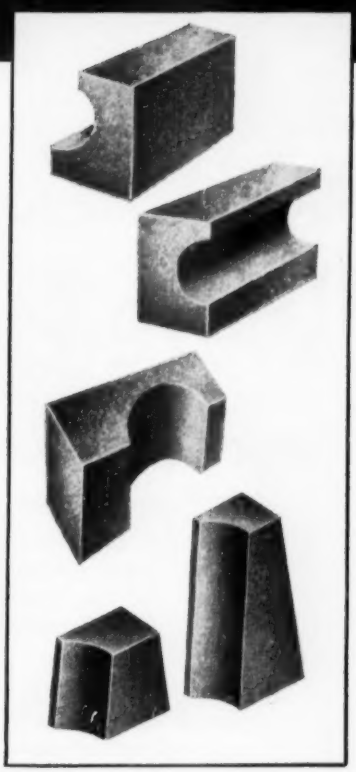


DIAGRAM FOR LONG BOILER LIFE

... and a formula for fewer shutdowns

CRYSTOLON* *Armor Blocks*



The way to get the most out of water tube boilers is to give them CRYSTOLON Armor Block protection.

CRYSTOLON Armor Blocks are made to afford maximum protection to tubes from localized heat generation and flame impingement. They're tapered for secure locking and to maintain intimate contact with the water tubes. They can be replaced readily from the fire side of the boiler.

You'll get these advantages

1. Ability to stand up under high heat (up to 3050°F).
2. Virtually impervious to slag penetration.
3. Practically clinker-proof.
4. Stand up under abrasion caused by the moving bed of stoker-fired furnaces.
5. Installation easy and inexpensive.

And when you need cement, call for Norton CRYSTOLON cement for laying up bricks — and for air-cooled wall construction. The time between shutdowns will be the greatest you have ever experienced.

Bulletin Sent Free

For more information about CRYSTOLON Refractories for Boiler Protection, write for Bulletin 862, NORTON COMPANY, 610 New Bond St., Worcester 6, Massachusetts.

Canadian Representative: A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

NORTON

REFRACTORIES

ENGINEERED Rx PRESCRIBED

Making better products... to make other products better

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

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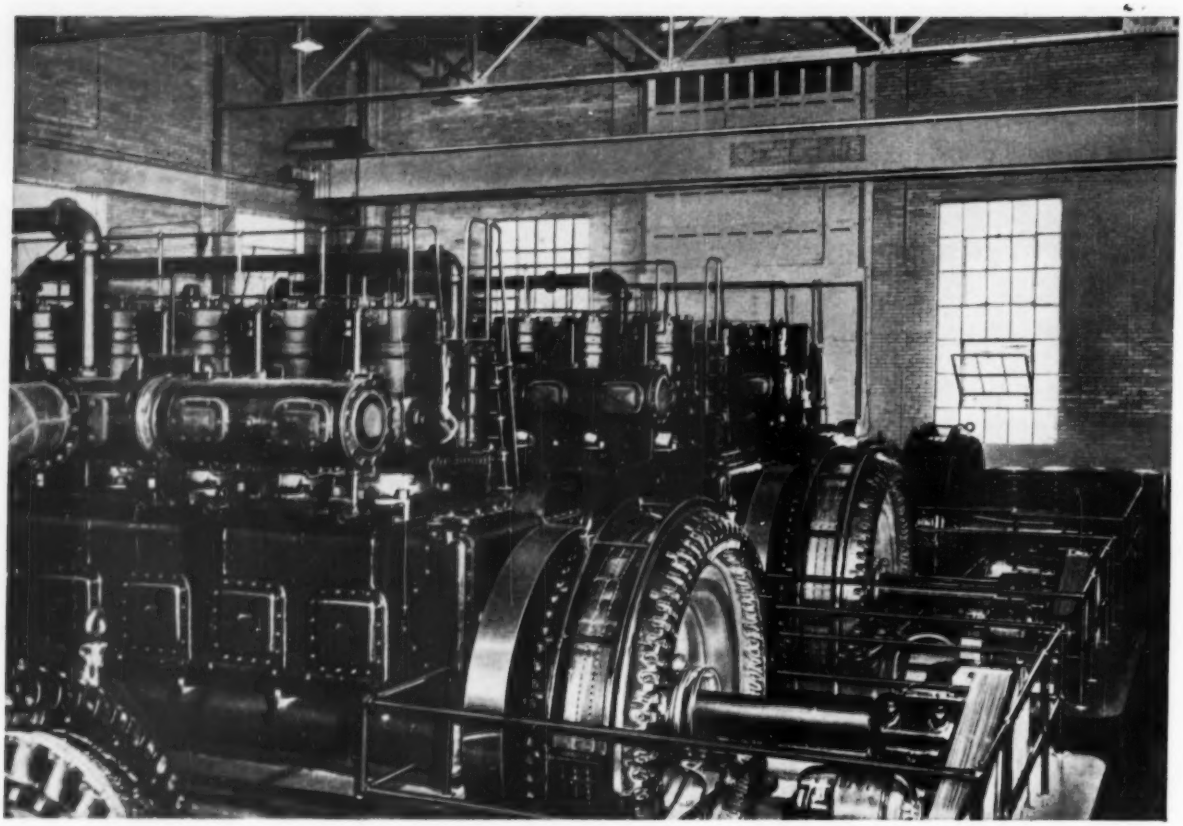


"We're Proud of This Plant!"

says Don H. Decker, — Plant Supt., Thumb Electric Cooperative, Ubly, Mich.

Manager Orville Hurford and Mr. Decker are justifiably proud of their 4-diesel engine generating station. The plant has been an outstanding financial success since the day it was first opened. Several times it has occupied #1 position on the REA Running Plant capacity chart.

Mr. Decker writes, "A large part of our operating success we attribute to Sinclair GASCON® D oil. It has given us an excellent rate of consumption while reducing wear. In fact, *cylinder and piston ring wear is much below normal based on other plants of equal capacity.* Something else we appreciate is the timely visits of the Sinclair Lubrication Engineers."

Top quality lubricants plus the assistance of Sinclair Lubrication Engineers are two of the reasons why Sinclair can play a large part in the success of *your* operation. Your local Sinclair Representative will be happy to explain the remaining reasons. Phone him or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS

save Wear and Replacement

For more data circle 573 on Post Card

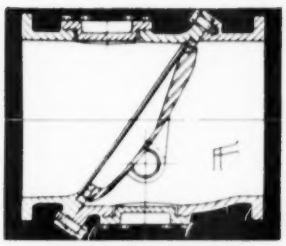
QUIET

Do Not Disturb Pipelines

You hang this sign on every line, when you install Chapman Tilting Disc Check Valves. For these unique check valves don't slam or hammer, under usual piping arrangements. And that means no damage to pipeline joints . . . virtually no wear in the valve itself.

Cross section at the right shows you how the airfoil design of the disc makes these valves *keep quiet* all their working lives . . . shows you why, in any installation, head loss is reduced over regular swing-type checks. Send for Publication No. 30, showing charts of test-results at leading engineering laboratories. Write today.

The Chapman Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS



Here's why
CHAPMAN Tilting Disc Check Valves
***Keep Quiet* All Their Lives**

This specially designed "airfoil" disc balances perfectly in open position . . . then drops easily to closed position (cushioned by the flow). No jarring or slamming, in usual pipe-layouts. Write for bulletin.

CHAPMAN (TILTING DISC) **CHECK VALVES**

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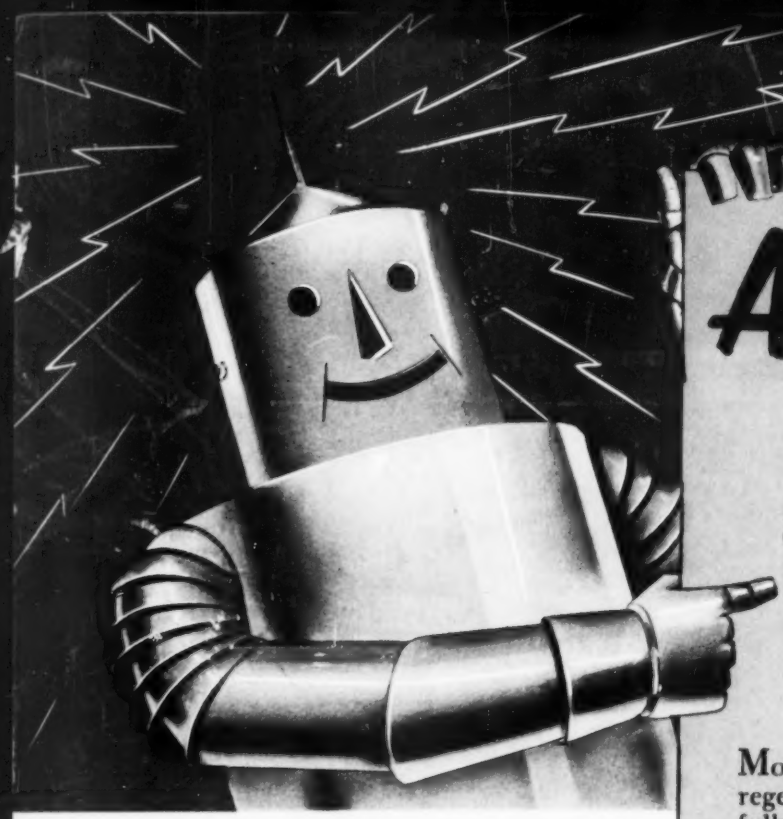


AUTOMATIC

Demineralization and Silica Removal by Ion Exchange Resins

MOTOR and diaphragm-operated valves make regeneration of Permutit Demineralizers fully automatic. This gives more positive control . . . eliminates the possibilities of costly errors . . . saves valuable man-hours formerly spent in regeneration.

In a recent installation for a 1450 psi boiler, two compact Permutit units fill all make-up requirements, regardless of changes in turbine loads . . . deliver a continuous supply of demineralized, silica-free water. What better way to eliminate scale and silica deposits!

HIGHEST PURITY MAKE-UP

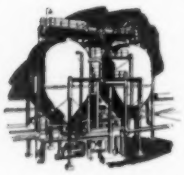
Effluents of Permutit Demineralizers have contained *total* electrolytes as low as 0.01 ppm and silica as low as 0.01 ppm! These values may be slightly higher under service conditions. In comparison, most distilled water contains 20 to 100 times more electrolytes . . . yet costs much more to produce.

INFORMATIVE NEW BULLETIN

You'll want this interesting book. Flow diagrams, illustrations and specifications explain key methods of demineralizing water and removing silica by ion exchange. Write for your copy, today!

THE PERMUTIT COMPANY, Dept. PE-1, 330 West 42nd Street, New York 36, N. Y., or the Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal, P. Q.

OTHER BASIC WATER CONDITIONING PROCESSES

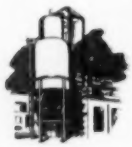


Sludge Blanket Hot Lime Soda

Full utilization of Permutit sludge-blanket principle assures high efficiency. Reduces hardness to region of 20 ppm . . . silica to 2.0 ppm. Lowers alkalinity . . . removes wide variety of solids.

Hot Zeolite—Permutit Q

Permutit Q—a styrene base resin resistant to high temperatures and pH values—replaces second stage phosphate treatment in hot-process softener. Results—residual hardness is completely removed at great savings in phosphate costs.



Deaerating Heater

Removes objectionable oxygen and CO_2 to prevent corrosion and pitting of feed lines, stage heaters, economizers, and boilers at high temperatures. Steam is used twice . . . deaerates water completely.

Precipitator

Softens water on space and time-saving sludge-blanket principle. Simultaneously removes turbidity, color, fluorides, reduces silica and lowers alkalinity.

PERMUTIT

ION EXCHANGE AND WATER CONDITIONING HEADQUARTERS FOR OVER 40 YEARS